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THE INDUSTRIAL SITUATION.

The financial events of the second half of October have been notable in their immediate effect on industrial conditions. There have been some pretty sharp convulsions in the last two or three years, and the decline in stock values began some time ago; but the steady march of commerce and industry was in no wise interrupted. Through it all consumption kept ahead of production, prices rose, labor demanded more and more, and real estate booms affected well-nigh every part of the country. Now for the first time in a long period, and dating from the sensational drop in copper, the industrial situation has changed, and with it we see contraction everywhere. It is now simply a question how far this check to industry associated so closely with financial troubles, can go as a result of what will be known hereafter as the panic of 1907.

It may not be unsafe or unwise to hazard the prediction that a turn has already come for the better, shortening the inevitable period of dullness and restriction. Each succeeding trouble of this nature finds the American people richer in accumulated wealth, stronger in developed resources, and with no loss of resilience. A continent with less than one hundred million population capable of sustaining in comfort one thousand million is not likely to be seriously checked or chilled by such trivial spasms as those of October, or by even great disasters like a civil war. Fortunately, at the present moment, there is general understanding of the soundness of all the underlying conditions and everywhere a resolve to repair by swift, well-directed endeavor the damage of the storm. The insanity of hoarding, shown as an intense craze of panic a couple of weeks ago, is again succeeded by normal confidence in banks and other depository institutions. It is felt, and the feeling cannot be manifested too strongly in actions, that the best policy for every business man is to pay up promptly. It is a mere truism that ten thousand dollars passed out in settlement of one account can liquidate in ten days ten times that amount of indebtedness as it goes from hand to hand, and come back ready to create new values.

Of course the effect of the troubles precipitated by the copper gamblers has been sharply felt in the electrical industries, ever in the vanguard of progress and calling for large sums in development. Several energy-transmission enterprises of inherent merit have been checked, and the underwriting on many trolley and lighting schemes is temporarily stopped. We do not think this will last long, but while it lasts the occasion is certainly a good one for pushing the manufacture and sale of all manner of minor appliances, apparatus and energy-selling plans. Now if ever is the time to prove the oft-asserted claims of electricity on the score of economy, comfort, safety, convenience and adaptability. In fact, the public utility companies have a great opportunity in pushing their business, rather than in contracting it, to be a powerful factor in alleviating the

situation and in laying deeper foundations for the larger prosperity of the near future. One thing we may now hope for, and that is at least a partial, if not a complete cessation of the corporation baiting that has gone on so long. It is well that the arrogance as well as the avarice of some modern leaders of finance and industry should be hit hard by the law, wherever evil and criminality have developed; but let us not forget that the corporate principle lies at the basis of our great modern development and is capable of infinite good if properly utilized. We do not need any more sumptuary laws, but rather fewer of them, enforced in a conservative spirit, and then every inhabitant of the country will be benefited.

Culmination of Wireless Telegraph Impulses at the Antipodes of the Sending Station.

The letter from Mr. Ernest F. Smith in our correspondence columns this week on the subject of the intensity of wireless telegraph signals at great distances from the sending station affords an opportunity for interesting speculation. Mr. Smith points out, although the same suggestion has been published before, that a wave which spreads at uniform speed and with uniform attenuation in all directions from a sending station on a sphere, should continually weaken in local intensity until it reached the equator of the globe with respect to that station. Beyond that distance the wave front tends to shorten and not to lengthen, until at the antipodes of the ending station it should tend to collect into a point with a splash or culmination. This would depend, of course, upon whether the rate of absorptive attenuation fell below a certain critical value. If, for instance, the absorption were so great as to make the wave inappreciably faint at a distance of say 100 miles, then it is clear that there would be no use looking for an antipodal splash 12,000 miles away. On the other hand, if the wave could be safely detected up to the equator from the sending station, or up to the ring 6000 miles off, so as to start fairly on its narrowing career, it would be reasonable to hope for a distinct culmination at the antipodes. Thus far we believe that there is no authentic or reliable information as to the reception of signals over 6000 miles away from their base, though there have been certain newspaper reports. There is, of course, no reason why they should not be found at such distances, if they are sufficiently strong at the start. All wireless telegraphists scattered about the ocean world should be encouraged to keep watch for, and record of, faint signals from afar, in order to transfer antipodal wireless telegraphy from the class of interesting speculation into the class of determined fact.

The Inductance of a Solenoid of Given Number of Layers.

The recent introduction of very high frequency currents into practical use for various purposes, such as wireless telegraphy, has brought the inductance of coils into prominence. Not only must the inductances of coils be known if their performances are to be under control, but these inductances must also be known to a relatively high degree of accuracy, hence in timing circuits as it is in target shooting with a rifle—a small deviation makes all the difference between hitting and missing. With low-frequency currents the inductance of coils is not so frequently needed to be known, if only because low-frequency induction coils almost always employ iron cores, and once we put an iron core into a coil, we can make the inductance of the coil almost what we please. The inductance of an iron-cored or ironclad coil is almost a meaningless term, since so much depends upon the permeability and previous magnetic history of the core. An air-cored coil, on the other hand, has a very definite inductance, that does not appreciably vary with the strength of the current in the coil. The article by Mr. Louis Cohen, on page 920 of this number, points out that Maxwell's formula for the inductance of a many-layered helix involves the assumption that the magnetic flux is uniform and parallel through all the turns. In other words, the formula applies only strictly to an indefinitely long helix. In ordinarily short helices the correction due to the divergence of the magnetic flux at the ends may be considerable. Formulas are given for reaching a closer determination of the inductance in a many-layered helix. These formulas are lengthy, but are not difficult to handle, and they ought to be of material service to those who have occasion to determine such constants with precision. The ordinary simple formula for the inductance of a single-layered helix without correction for divergence of magnetic flux near the ends depends only on the volume of the helix and on the number of turns of wire per linear centimeter of the winding. If we call this number the multiplicity of the winding, the simple formula makes the inductance in absolute henrys equal to 4π times the cylindrical volume enclosed by the winding in cubic centimeters, times the square of the multiplicity. The article supplies a brief and seemingly valuable formula of closer approximation.

The Influence of Transoceanic Wireless Telegraphy on Submarine Cable Traffic.

Now that wireless telegraph messages are being forwarded across the Atlantic Ocean, and it is announced that an ether circuit has been opened between Ireland and Cape Breton Island for traffic, it is worth while considering what effect wireless transoceanic telegraphy is likely to have on the submarine transoceanic cable telegraphy. Up to the present time, the field and scope of wireless telegraphy have been practically confined to maintaining communication with or between ships at sea. In this field, wireless telegraphy is without a rival, and its effect has been profound. Formerly, a vessel outside of legal three-mile shore limits was virtually beyond the pale of knowledge, government guidance or communication, except in so far as other incidentally passing vessels might bring knowledge or communication. We have changed all that forever. Already the large passenger steamers crossing the Atlantic are commonly within receptive range of news and communication, either from one shore or the other, all the way across. It is reasonable to hope that in times to come no large vessel will ever be out of receptive communication with her head office. This will mean that the ocean, which as we know represents about three-fourths of the surface of the globe, is already in process of being transformed from vacant unreclaimed territory to controlled territory, and the control will no longer be merely vested in the government or governments possessing the largest and most efficient navies, but also in those which possess the best wireless telegraph equipments. It is hardly possible for this to work otherwise than in the direction of international unity. The ether surrounding the globe belongs as much to Switzerland, without a port, as to England or Japan, which are nearly

all port. When persons or countries are all inhabitants of the same vehicle or environment, mutual friendship and forbearance are forced upon all alike. Hitherto wireless telegraphy has had so much to do with building up and establishing communication with floating stations and ships at sea that it has had hardly any effect on submarine-cable traffic. Now, however, it attempts to come into competition with the submarine cables. It must take a long time, however, before that competition can become serious. If wireless telegraphy were not to advance beyond its existing stage of development it is doubtful whether it could ever become a serious competitor. But wireless telegraphy is still young, and the atmosphere above our globe is responsive to all kinds of artificial electromagnetic stimulus. We cannot foretell what advances wireless telegraphy may make as it grows older, whereas cable telegraphy has remained almost at a standstill for many years. In time, it might be that no more cables would come to be laid; but for the present the competition has only just commenced, and much growth must take place before it becomes serious.

THE POWER FACTOR OF CONDENSERS.

A condenser is known to be a highly efficient piece of apparatus for storing small quantities of electric energy during brief periods of time, under favorable conditions. An air-condenser is only able to store a relatively small quantity of energy at ordinary atmospheric pressures, owing to the electric weakness of air. At ordinary atmospheric pressures air breaks electrically when the electric intensity reaches about 100 units, and consequently air will only hold about 400 ergs of electric energy per cubic centimeter. Nevertheless, a well-insulated air condenser, taking its electric energy from alternating source of e. m. f., will hold it during each half cycle and return it to the circuit with extremely little loss. The great bulk of an air-condenser of appreciable storage capacity limits the applicability of the apparatus. A cubic meter of ordinary air in an air-condenser can hardly hold 40 joules, although under a pressure of, say, five atmospheres it may hold 25 times as much. With condensers of solid dielectric, such as mica, paper or glass, we can stow away more energy to the unit of space, partly on account of the greater dielectric constant, or specific inductive capacity, with which the energy stowage rises proportionately, and partly on account of the greater electric strength, or voltage capability of the insulator, with which the energy storage rises as the square. A glass condenser may stow away 25,000 ergs per cubic centimeter, or about 60 times as much as air; so that for the same energy contents, or for the same horse-power under alternating voltage, the glass condenser may be about one-sixtieth as large as an atmospheric air condenser. The practical advantage thus in favor of the glass condenser is great.

Unfortunately, however, the condenser of solid material, although it gains so much in compactness, loses markedly in efficiency. There is leakage of the electric charge in the condenser, and there is hysteresis or a lagging behind of the stowage with reference to the impressed e. m. f. If simple alternating e. m. f. be impressed upon the solid condenser, the charging current will not be exactly 90 deg. ahead of the e. m. f. in phase. It may be, say, 88 deg. ahead. This would mean that the particular condenser had a power factor of 3.5 per cent, or that this condenser absorbed 3.5 per cent of the energy which it received for storage. An efficiency of 96.5 per cent might still be regarded for many practical purposes as satisfactory; but this is not the worst of the defect. The principal objection lies ordinarily in the fact that the energy flow makes the dielectric hot, and dielectrics behave worse at high temperatures than at low temperatures. Their leakage increases, their hysteretic loss increases, and their dielectric strength decreases. Consequently, the power which can be safely given to the solid condenser is much less than could be given to it if it kept cool. Compressed air is, therefore, perhaps the most absorbtive substance, and the most compact energy receiver of all, under practical conditions.

The power factor of a condenser is an important property of the condenser in view of the above considerations. For some purposes the power factor is more important than either the capacity of the condenser, or its maximum watts. The August number of the *Bulletin* of the Bureau of Standards contains a paper on the measurement of the power factor of condensers, by Mr. F. W. Grover. A number of methods of measurement are discussed, all modifications of alternating-current Wheatstone-bridge tests. The results obtained with these different methods are compared, and are shown to be in satisfactory mutual agreement. The results are stated in terms of the angle of quadrature defect, or the complement of the angle of lead of the condenser current with respect to the simple alternating charging e. m. f. A good mica condenser is shown to have a quadrature defect of from half a minute to five minutes of arc, corresponding to a power factor of from 0.015 per cent to 0.15 per cent. Some mica condensers are stated to have a quadrature defect of more than 10 deg. How they can be so defective without breaking down altogether it is difficult to imagine. Among the paper condensers tested, the quadrature defect varied from 6 minutes up to 8 deg. Telephone condensers seem to have had the largest defect. In most cases of telephonic central-station use, a small defect is not of great importance, but in paper insulated telephone cables it is of considerable importance. In such paper cables it is known that the presence of even a small quantity of water-vapor has a marked influence upon the quadrature defect and upon the power factor. Whether the paper condensers, which are usually soaked in melted paraffin wax, contained water-vapor is not stated.

The important practical result is indicated by the research that absorption in a condenser, or the property of accumulating residual charges; as well as the property of presenting a different capacity by direct deflection with different times of charging, are all closely connected with the power factor, so that if the power factor can be kept very small, the polarization, hysteresis, and absorption in the condenser will be likewise very small. Another important fact deduced from the research is that the quadrature defect of a certain good mica one-microfarad condenser was 90 seconds of arc at 50 cycles, 75 seconds at 100 cycles and 38 seconds at 970 cycles per second; so that the defect and the power factor appear to diminish with the frequency. The research has marked value because not only in power applications, but also in wireless signalling, the condenser has increasing utility, and a low power factor is of importance.

How to Deal with the Trusts.

At the close of the recent special convention on trusts in Chicago, of the National Civic Federation, the committee on resolutions presented the following report: "After 20 years of federal legislation, as interpreted by the court, directed against the evils of trusts and combinations and against railroad rebates, beginning with the Interstate Commerce Act of 1887 and the Anti-Trust Act of 1890, a general and just conviction exists that the experience gained in enforcing these federal acts and others succeeding them demonstrates the necessity of legislation which shall render more secure the benefits already gained and better meet the changed conditions which have arisen during a long period of active progress, both in the enforcement of statute law and in the removal of grave abuses in the management of railroads and corporations. These changes now demanded are:

"First—Immediate legislation is required, following the recommendation of President Roosevelt and the Interstate Commerce Commission, permitting agreements between railroad corporations on reasonable freight and passenger rates, subject in all respects to the approval and supervision and action of the Interstate Commerce Commission.

"Second—The enforcement of the Sherman Act and the proceedings under it during the administrations of Presidents Harrison, Cleveland, McKinley and Roosevelt have accomplished great national results in awakening the moral sense of the American people and in asserting the supremacy and majesty of the law, thus effectually refuting the impression that great wealth and large corporations were too powerful for the impartial execution of law. This great advance has rendered more secure all property rights, resting as they must under a popular government, on universal respect for and obedience to law. But now that this work is accomplished, it has revealed the necessity for legislation which shall maintain all that the Sherman Act was intended to secure and safeguard interests it was never expected to affect.

"As the next step in executing the determination of the American people to secure in all industrial and commercial relations justice and equality of opportunity for all, with full sympathy and loyal support for every effort to enforce the laws in the past, we urge upon Congress without delay to pass legislation providing for a non-partisan commission, in which the interests of capital, of labor and of the general public shall be represented.

"This commission, like a similar commission which proved most successful in Germany in 1870, shall consider the entire subject of business and industrial combinations, and report such proposals as to the formation, capitalization, management and regulation of corporations (so far as the same may be subject to federal jurisdiction) as shall preserve individual initiative, competition and the free exercise of a free contract in all business and industrial relations. Any proposed legislation should also include modification of the prohibition now existing upon combinations on the following subjects:

"1. National and local organizations of labor and their trade agreements with employers relating to wages, hours of labor and conditions of employment.

"2. Associations made up of farmers intended to secure a stable and equitable market for the products of the soil, free from fluctuations due to speculation.

"3. Business and industrial agreements or combinations whose objects are in the public interest as distinguished from objects determined to be contrary to the public interest.

"4. Such commission should make a thorough inquiry into the advisability of inaugurating a system of federal license or incorporation as a condition for the entrance of certain classes of corporations upon interstate commerce, and also into the relation to the public interest of the purchase by one corporation of the franchises or corporate stock of another.

"On no one of these subjects must what has been gained be sacrificed until something better appears for enactment.

"On each of these the conference recognizes differences between good men. On all it asks a national non-partisan commission to be appointed next winter to consider the question and report at the second session of the approaching Congress for such action as the National Legislature, in the light of this full investigation, may enact.

"The examination, inspection and supervision of great producing and manufacturing corporations, already begun by the Department of Commerce and Labor and accepted by these corporations, should be enlarged by legislation, requiring. through the appropriate bureaus of the Department of Commerce and Labor, complete publicity in the capitalization, accounts, operations, transportation charges paid, and selling prices of all such producing and manufacturing corporations whose operations are large enough to have a monopolistic influence. This should be determined and decided by some rule and classification to be devised by the commission already proposed.

"The conflicts between the State and federal authority raised in many States over railroad rates, being now under adjudication and under way to a final and ultimate decision by the federal Supreme Court, this conference deems the expression of any opinion on these issues unfitting, and confidently leaves this great issue to a tribunal which, for 118 years, has successfully preserved the balance between an indissoluble Union and indestructible States, defining the supreme and national powers of the one, and protecting the sovereign and individual powers of the other."

The resolutions were adopted as read, after which the conference adjourned sine die.

Mr. Acheson Before New York Electrical Society.

At Columbia University, New York, on October 30, before the New York Electrical Society, Mr. E. G. Acheson presented a very interesting paper, entitled "A New Departure in Lubrication." It dealt with his invention and researches in "deflocculated" graphite, to which attention has already been directed in these pages.

Aquadag is the name Mr. Acheson has given to the new lubricant made by suspending graphite in the water, while Oildag is the name he has selected for the lubricant made by suspending graphite in oil. Deflocculated graphite in water has been found to make an excellent lubricant for light work, the graphite preventing rust of any of the parts, while for heavier work the Oildag lubricant has been found ideal, he said. He went on to tell that both Professor C. H. Benjamin, dean of the engineering schools of Purdue University, and himself had made exhaustive tests, each one of which demonstrated the wonderful efficiency of these new lubricants.

Possibly the most satisfying test of all was that made at the works of the General Electric Company at Schenectady, N. Y., under the supervision of W. L. R. Emmett. These tests were not made to include the co-efficient of friction, but of the temperature and the surface speed of the shafts in the bearing. The shaft measured 7½ ins. in diameter, resting in a bearing 21 ins. in length. The test covered both forced lubrication and oil-ring lubrication. Not a great deal of advantage was shown in the case of the forced feed lubrication, the presence of the graphite holding down the temperature but a very little. In the test on the oil ring feed, however, very pronounced advantages were shown in favor of the graphite.

It is astonishing to think that the graphite content as used in these tests was 0.35 of 1 per cent of the weight of the oil, but the tests showed that with the same pressure and temperature "a shaft can be run from 50 to 100 per cent faster with the graphite in the oil than with the plain oil."

"The world was shocked a short time ago," said Mr. Acheson, "by the appearance in the daily press of an account of the utter annihilation of one of the plants of the Du Pont Powder Company. The account informed the world of the sacrificing

of the lives of a number of Du Pont employes, the maiming and crippling of many more, and of a property destruction extending over many square miles, and, further, this was caused by the overheating of a bearing. I believe I am quite within the truth when I state that this frightful catastrophe might have been entirely obviated had that bearing been lubricated with Oildag. A thin film of graphite between two metallic surfaces will prevent their seizing, cutting or heating from friction."

Mr. Acheson stated he had run a heavy car lubricated with Oildag over 6000 miles without the necessity of cleaning the spark plugs, and, what is still more remarkable, without the necessity of grinding the valves, while materially reducing the consumption of oil. The results would indicate that the use of Oildag in the gas engine will eliminate the pitting of the valve seats.

The surfaces produced on the valve seats are remarkable, being much finer than is possible of attainment by any mechanical finishing, the graphite being incorporated in the body of the metal.

The address closed with the intimation that the use of this new and modern lubricant will greatly reduce the consumption of lubricating oils, and the audience realized that another leg is about to be knocked from under the Standard Oil Company, the major part of whose business has been the sale of lubricating oils. Tests recorded give assurances that the oil consumption can be reduced over 25 per cent, which will be a tremendous volume considering the immense quantity of lubricating oils used annually.

Lighting Effect at Jamestown Exposition.

Thanks to the talent and ingenuity brought to bear by illuminating engineers on each new exposition in America, we have come to look to these shows for novel lessons and effects in lighting. In this respect, the Jamestown Exposition maintains the traditions very successfully, and strikes a new note in the illumination of the Administration Building, facing on Raleigh Court. We are able to present herewith a good view showing admirably the effect obtained. Just back of the dome of the building, a battery of search lights and projectors has been placed, and their beams, eight in number, are fanned out so as to produce a superlatively beautiful crown of light, resembling closely an aurora. Several of these broad bands of white light stream across Hampton Roads, and while passing under them on the ferry boats, at a distance of a few miles, it is curious to note how suddenly and absolutely the rays disappear, as though sawn off. It will be understood that a colored or spectrum effect can readily be obtained by the use of color screens.

AURORAL EFFECT, ILLUMINATION OF JAMESTOWN ADMINISTRATION BUILDING.

The general use of search lights at Jamestown is indeed quite notable, the General Electric Company having furnished no fewer than 12 18-in. and 10 30-in projectors, all of whose light is, of course, supplemental to the decorative and service incandescent lighting, much of which is also seen in our illustration.

Electric Vehicles at the Madison Square Garden Automobile Show.

The eighth national automobile show of the Association of Licensed Automobile Manufacturers was held in Madison Square Garden, New York, Nov. 2-9, inclusive. Unlike the show held the week previous in the Grand Central Palace, under the auspices of the Automobile Club of America, the Garden show contained many electric vehicles of both the pleasure and commercial types. To be sure the gasoline vehicles continue to monopolize space and attention; but the past few years have seen a wonderful advance in the use of electrically-propelled vehicles, ascribable to a number of causes.

While the design of the electric pleasure vehicle has always followed carriage makers' standards where lines, construction and finish are concerned, so that in appearance these vehicles remain practically the same, attention to details has resulted in a greater mileage with the same motor and battery equipment than was heretofore attainable. The manufacturers no longer make immoderate claims or guarantees for their equipments; most of them supplying the motor and vehicle and equipping the outfit with whatever make of storage battery the purchaser specifies. The latter is not deluded; and while it is only natural that he should desire some approximation as to the capabilities of the vehicle, the manufacturer simply states that such and such results have been obtained with a certain equipment under certain conditions. In order that some estimate of the mileage capabilities of the electric vehicle may be had, it might be well to state that nearly, if not all the manufacturers of electric vehicles have built machines which have exceeded 100 miles on a single battery charge under favorable conditions; one maker claiming 140 miles at a speed of 12½ miles per hour.

To this day no one questions the superiority of the electric vehicle for commercial purposes; one great feature in its favor being that any driver of ordinary intelligence can operate it, whereas the gasoline vehicle must at all times be in the hands of an experienced man. The features of the various designs of electric vehicles are pointed out in the brief descriptions which follow:

The Anderson Carriage Company, of Detroit, Mich., builder of the "Detroit Electric," showed two pleasure vehicles—a

victoria and a coupé. An Elwell-Parker motor rated at from 2 to 3 horse-power is used, and the power is transmitted from the motor to a countershaft through a Renold chain running in oil. The countershaft, on which is placed the differential gearing is fitted with ball bearings. The controller allows forward speeds of from 8 to 23 miles per hour and on reverse, gives speeds of from 8 to 13 miles per hour. In pulling the controller handle backward, the circuit is opened and an emergency brake applied. A feature of the equipment is the lock switch, which is operated by the foot through two push buttons in the toe-board of the vehicle. The battery consists of 24 cells divided into two units of 12 cells and placed in the front and in the rear parts of the vehicle under detachable hoods. Drip pans under the battery prevent any acid from reaching any part of the vehicle or wiring. Generous battery space is provided, permitting the use of various size cells.

The Studebaker Automobile Company, of South Bend, Ind., exhibited an ambulance, runabout, stanhope, victoria, 14-passenger 'bus, light delivery wagon, 2500-lb. express wagon and a 1500-lb. car chassis. The pleasure vehicles are equipped with a single motor, and the battery is divided into two units and mounted over the wheels under hoods. The vehicles are designed for a speed of 15 miles, although the speed varies according to the tire equipment. The omnibus is fitted with two motors and 40 cells of battery divided into four units. The battery is carried beneath the body of the car in a trussed compartment suspended from the frame of the running gear. The light delivery wagon is specially designed for light work. A single Westinghouse motor is used with an Exide battery. The chassis of a 1500-lb. car for delivery work is built of re-enforced angle iron, and is equipped with two motors and a 40-cell battery. The 2500-lb. wagon is also equipped with two motors and a 40-cell battery. Chain drive is used on all the vehicles.

The Columbus Buggy Company, of Columbus, Ohio, had four pleasure vehicles on exhibition. The vehicles are equipped with Elwell-Parker motors and a 24-cell Exide battery. The latter is arranged half under the front hood and half under the rear hood, and the motor is located under the seat. The motor, battery, controller, wiring, etc., are all easy of access and are fitted to a pressed-steel chassis frame. Double chain drive is used and the axles are non-revolving, the hubs being provided with roller bearings. The motor, which is equipped with ball bearings, is set in an aluminum supporting frame. The controller is of the radial type with combined reversing switch, self-cleaning contact points and interlocking device preventing reverse changes being made until energy is shut off by the operation of the speed control lever. Speeds from 5 to 20 miles per hour forward and backward are arranged for.

The Babcock Electric Carriage Company, of Buffalo, N. Y., showed four models of pleasure vehicles—a roadster, victoria phaeton, special stanhope and a coupé, each meriting attention. The roadster can develop a speed of 26 miles per hour with an intermediate range of from 6 to 26 miles per hour. Double chain drive from a 2-hp motor suspended beneath the seat is used. The battery equipment consists of 36 cells of the company's own make, half of the cells being placed in front and half in the rear of the vehicle directly over the wheels. The chassis is of reinforced wood. The company recommends certain types of tires, claiming that any other type of tire will materially reduce the speed and mileage. The controller used is of the company's own design and allows five forward speeds and two reverse speeds. A stock car of this type has traveled 100 miles on a single charge. The victoria-phaeton and the coupé have similar battery and motor equipments. The special stanhope is equipped with a 3-hp motor and 40 cells of battery. Ball bearings are provided on the front wheels and roller bearings on the rear wheels. The controller allows three forward and two reverse speeds. The stanhope has in addition an accelerator whereby all of the speeds may be increased, the highest speed being 18 miles per hour. In all of the cars except the stanhope the speed is controlled almost entirely by a foot lever. After the controller handle has been set for the desired speed it is not necessary to touch the handle again, unless the rate of speed is changed. Once under way the car can be slowed down, allowed to coast, or the countershaft brake applied and the car brought to a stop, with but one movement of the foot lever.

The Pope Motor Car Company's Waverley Department, Indianapolis, Ind., builder of Pope-Waverley electric vehicles, exhibited 11 cars, eight pleasure vehicles and three commercial wagons. The pleasure vehicles comprised a surrey, coupé, stanhope, victoria-phaeton, coupé-phaeton, phaeton with English canopy, and two runabouts. The motors used on all of the vehicles are of Pope-Waverley design and either Exide or National batteries are supplied. The surrey is equipped with two motors and 42 cells of battery. Speeds ranging from 5 to 15 miles per hour are provided. The coupé is equipped with a single motor and 30 cells of battery, 10 in the front compartment and 20 in the rear compartment. The stanhope is also equipped with a single motor and 30 cells of battery. The three phaetons are equipped with single motors and 30 cells of battery. Both of the runabouts are similarly equipped with single motors and 30 cells of battery. All of the vehicles are driven through "herring-bone" type gearing running in oil and protected in dust-proof cases. The single-motor vehicles are equipped with double brakes acting on the rear hub. There is also a brake on the armature shaft. The double-motor vehicles are equipped with two double-acting brakes on the rear hubs. The commercial vehicles shown comprised an express wagon equipped with two 6-hp motors and an open-body and a closed-body delivery wagon. The latter vehicles are equipped with single motors and 42-cell batteries.

The Baker Motor Vehicle Company, of Cleveland, Ohio, made a display of five pleasure vehicles and one commercial wagon, the latter a police patrol. The pleasure vehicles shown were a victoria, coupé, special roadster, a landaulet and a polished chassis for any body. Annular ball bearings are used on all revolving parts of the Baker vehicles. The motors used are specially built by the General Electric Company and are claimed to be fool-proof. The victoria is equipped with a 2-hp motor and 24 cells of battery of any make. The cylindrical controller gives six forward and three reverse speeds. The transmission is by silent chain reduction, single chain drive. The coupé has a motor and battery equipment similar to the victoria. The roadster is equipped with a 3½-hp motor and 40 cells of battery. The transmission is by planetary gear reduction, shaft and bevel gear drive. The controller gives nine forward speeds and three reverse. The batteries are connected in parallel to the fifth speed and after that in series. Eight speeds forward from 8 to 40 miles per hour are obtained without the use of a resistor. The mileage capacity of the roadster at 14 miles per hour is practically 100 miles on a single charge. The landaulet is equipped with a 6-hp motor and 40 cells of battery. The mileage capacity at 12 miles per hour is 50 miles on a single charge, and at the rate of 16 miles per hour, 40 miles.

The Rauch & Lang Carriage Company, of Cleveland, Ohio, showed a stanhope, a coupé and a landaulet. The vehicles of this company are equipped with motors built by the Herter Electric Company, of Cleveland, and with Exide batteries. Roller bearings are used in the wheel hubs and the batteries are located in front and rear over the springs. Annular ball bearings are used on the motor and on the countershaft and the latter are supported in a sub-frame which is itself suspended from the chassis at three points. The motor brake and controller are also assembled to the sub-frame. Transmission from motor to countershaft is by means of a silent chain. The motor is designed to operate on a potential of 48 volts for all speeds. Two starting speeds are provided. The third position on the controller gives the first running speed, which is obtained by having powerful shunt coils along with the series coils. The second and third running speeds are obtained without the use of the shunt field coils. The fourth speed is obtained by reversed shunt field coils operating in conjunction with the series field coils. The controller is of the flat radial type, two movable copper-leaf contacts making the necessary connections to obtain the various speeds. The stanhope is equipped with 24 cells of

battery and the radius of action on a single charge is claimed to be as high as 100 miles, depending on the tire used. The coupé's equipment is similar to that of the stanhope. The landaulet is equipped with 24 cells of battery of a different type and has a maximum speed of 18 miles per hour. All the vehicles are equipped with a patented controller handle which possesses many valuable features.

The Electric Vehicle Company, of Hartford, Conn., builder of the Columbia electric cars, displayed five pleasure vehicles—a brougham, landaulet, hansom, victoria-phaeton and victoria. The leading features of the phaeton include a divided Exide battery of 24 cells with the weight distributed over both axles; motor and all working parts are attached to the body, making it possible to run over rough surfaces at high speeds; reduction gear and enclosed chain connecting the motor to the balance gear on the live rear axle, which runs in a tubular casing with all parts of the mechanism housed to exclude dirt; three forward speeds up to 15 miles per hour and two reverse speeds. The other vehicles have the running and operating parts attached to a chassis of cold-pressed steel. The motor is of special design and is connected to the driving axle by double-reduction, noiseless, helical gearing. There are five forward speeds provided up to 18 miles per hour and three reverse speeds. The battery consists of 44 cells of the latest Exide type and is carried in a single tray beneath the carriage body.

The General Vehicle Company, of New York, displayed four pleasure vehicles and a number of commercial trucks and wagons. The latter have unusually long wheel bases and low suspension so that they differ somewhat in appearance from the wagon that one is accustomed to see and from those previously made by the company. The pleasure vehicles also reveal departures from the company's previous practice. The landaulet, victoria-phaeton and runabout, all have pressed-steel frames with long, semi-elliptical suspension, single motor with differential countershaft, silent chain transmission and roller bearings. The landaulet is patterned to some extent after gasoline practice, the battery being placed forward under the bonnet.

The Alden Sampson Manufacturing Company, of Pittsfield, Mass., had one of the most striking exhibits in the commercial vehicle section of the show. A special form of tractor which has been given the title of the gas-electric road train, because the motive power is originally supplied by a gasoline engine of standard type direct-connected to a C. & C. generator. The latter furnishes energy to the tractor motors and to the motors on two trailers. Each car has a capacity of 6 to 8 tons and each is equipped with its own motors. The tractor contains the power plant located in front and has a carrying capacity of 3 to 4 tons. Owing to the use of steel tires a separate spring supported frame is provided for the power plant. The voltage can be varied through a fairly wide range and series-paralleling is effected by a rotary switch which is interlocked to the starting rheostat making it impossible for the operator to damage the apparatus. Switches are provided enabling the tractor to operate the train with its own motors only or to enable a car or cars to be operated without running the tractor through an extension cable of suitable length. The train is easily handled by one man, the control and steering gear being centered on the tractor. The speed of the train loaded with 20 tons on level roads is 6 miles per hour.

Western Electrical Inspectors Convention.

The third annual meeting of the Western Association of Electrical Inspectors was held at Hotel Ryan, St. Paul, Minn., Oct. 22, 23 and 24, 1907. Thirty members were present, including fourteen municipal inspectors. The following special committee reports were submitted and discussed: Committee on national electrical code, committee on outside wiring, committee on theater wiring and show equipment, committee on show-window and display lighting, committee on instructions to the public concerning the safe operation of electrical wiring and apparatus, committee on wiring for electric cranes, committee on laws and ordinances, committee on architects' specifications.

The following addresses were delivered: Approved Electrical Fittings, by Dana Pierce, electrical engineer, Underwriters' Laboratories, Chicago. Joint Construction Pole Line, by H. B. Gear, general inspector, Commonwealth Electric Company, Chicago. Electrical Inspection from the Viewpoint of the Central Station, by A. G. Munson, assistant superintendent, St. Paul Gas & Electric Company, St. Paul, Minn. Electrical Inspection from the Viewpoint of the Telephone Exchange, by C. M. Mauseau, general manager, Northwestern Telephone Exchange Company, Minneapolis, Minn. Flexible Cord for Pendants, by H. T. Wreaks, secretary, Wire Inspection Bureau, New York.

Of seventy-three proposed changes in the National Electrical Code, twenty-four were approved and thirteen were referred back to the committee for further consideration, with instructions to report back to the executive committee with power to act.

Tours of inspection were made to electrical installations, including underground system of tunnels operated by the St. Paul Gas & Electric Company; conduit installation in reinforced concrete building; open wiring in can manufacturing plant; theater wiring equipment in two houses, one new and up to date, the other old.

Waldemar Michaelsen, city electrician of Omaha, Neb., exhibited a number of fittings and materials used in electrical construction work in Berlin, Germany. In most instances they suffer by comparison with those bearing Underwriters' approval in the United States.

The following officers were elected for the year 1907-8: President, E. R. Townsend, Chicago; first vice-president, Geo. D. Bayle, Chicago; second vice-president, H. C. Harris, Columbus, Ohio; secretary and treasurer, W. S. Boyd, Chicago. Executive Committee—Chairman, Fred G. Dustin, Minneapolis, Minn.; Geo. D. Bayle, Chicago, Ill.; F. R. Daniel, Indianapolis, Ind.; H. C. Harris, Columbus, Ohio; Waldemar Michelsen, Omaha, Neb.; J. H. Montgomery, Detroit, Mich.; W. C. Stewart, St. Joseph, Mo.; E. R. Townsend, Chicago, Ill.; F. D. Varnam, St. Paul, Minn.; secretary, William S. Boyd, Chicago.

The next meeting will be held in Chicago, in October, 1908.

Some Interesting Steam Turbine Data.

The improvement in economy brought about by the use of steam turbines, as compared with reciprocating engines as a class, is due in great part to the fact that a turbine can operate effectively in the lower pressure ranges, while with reciprocating engines mechanical conditions prevent a possibility of high degrees of expansion. An illustration of the wide range of pressure that can be utilized to advantage, is furnished by the following tests on a 9000-kw Curtis generating unit installed in Chicago:

Load in Kilowatts.	Gauge Pressure Pounds.	Vacuum Inches.	Superheat Degrees F.	Water Rate Pounds per kw-hour
5,374	182	29.43	133	13.15
8,070	179	29.55	116	13.0
10,186	176	29.47	147	12.9
12,108	182	29.34	148	13.05
13,900	198	29.31	149	13.6

To take the set of readings nearest to full load, it will be seen that the steam was worked from a pressure of 179 lbs. gauge to a vacuum of 29.55 ins.; that is, to a point within less than a quarter of a pound of an absolute vacuum. In this state of vacuum, steam has a volume over four times as great as under a 28-in., and eight times as great as under a 26-in. vacuum.

The ease with which the turbine can handle this large volume of steam, and utilize the additional energy that becomes available, is clearly expressed in the water rate of 13 lbs. per kw-hour which was obtained. This rate, it might be added, represents the largest return from the fuel which has so far been realized by any steam process.

As a further instance of the high economy of turbines, the test of a 5000-kw unit installed in Boston may be cited. This test gave a water rate of 13.52 lbs. per kw-hour with a load of 5195 kw, a steam pressure of 173.7 lbs., a superheat of 142 degs. F. and a vacuum of 28.8 ins.

In this connection, it is decidedly interesting also to note the range of, and increase in, size of turbine units. Commercial shipment of Curtis turbo-generators began about four and a half years ago. In the short period of time that has elapsed since then, shipments have been made aggregating in normal rating over three-quarters of a million kilowatts, while the total number of units sold to date is considerably above a thousand, with an aggregate capacity of over 1,000,000 kw. The demand for the various sizes is indicated in a general way by the following abbreviated list. Over two hundred and fifty of 500-kw units have been sold, about seventy-five of both the 1000 and 1500-kw sizes and some fifty 2000-kw units. Orders have been received for a number of the new 14,000-kw units.

Electrically-Operated Reduction Mill.

The Boston Consolidated Mining Company is just completing at Garfield, on Salt Lake, a short distance from Salt Lake City, Utah, a stamp mill of 3000 tons daily capacity, which is to depend for its operation on electric motors receiving energy from the long-distance transmission line network of the Telluride Power Company. Three separate lines of this company enter the sub-station at this mill. The lines are operating now at 40,000 volts, and are designed to be raised later to 60,000 or 80,000 volts. The sub-station is of 5000 kw capacity. Westinghouse induction motors are used in the mill.

The Depression in Public Utility Securities.

It is well known that in the recent panic, as in the long depression that preceded it, public utility corporation stocks and bonds have suffered severely. Indeed, a point has been reached from which it should now be possible to begin the return to quotations nearer real values. A short table compiled by the *Wall Street Journal,* ranging over a year, gives a good idea of the situation. Out of nineteen of the most active public utility securities, stocks and bonds, traded in on the New York Stock Exchange, fifteen show declines of 50 or more points from their high prices of 1906, while Consolidated Gas and Third Avenue each show a decline of more than 100 points. The depreciation in market values of the nineteen issues from the high of 1906 to the low of 1907 amounts to $468,014,286. Of this amount Inter.-Met. common and preferred, and the company's 4½ per cent bonds, together furnish $107,877,463.

Below are exhibited the amount of outstanding stock or bonds of the nineteen issues, with the high for 1906 and the low for 1907, the number of points decline and the depreciation in market values:

	Amount Outstanding.	1907. Low.	1906. High.	Dec.	Depreciation.
B. R. T.	$45,000,000	29	94⅛	65⅛	$29,306,250
B. R. T. 4s	32,702,000	62	100	38	12,426,760
Brooklyn United Gas.	15,000,000	99⅞	178	78⅛	11,718,750
Consolidated Gas.	80,000,000	74	181¼	107¼	85,800,000
Consolidated Gas 6s.	20,000,000	92	168¾	76¾	15,350,000
Detroit United	12,500,000	32¼	102	69¾	8,718,750
Inter-Met., com	92,928,886	4⅞	55⅜	50¾	47,161,409
Inter-Met., pfd.	45,479,800	15	87⅜	72⅜	32,916,004
Inter-Met., 4½s.	67,805,000	49¼	90¼	41	27,800,050
Manhattan Railway.	60,000,000	100⅞	162	61⅛	36,675,000
Met. Street Railway.	52,000,000	30	127	97	50,440,000
North American.	29,792,300	41⅛	107	65⅞	19,625,676
People's G. L. & C.	32,969,100	70¼	103	32¾	10,797,380
Third Avenue.	15,995,800	20¼	139⅛	118⅞	19,015,007
Third Avenue 4s.	36,943,000	45½	95½	50	18,471,500
Tol. Railways & Light.	15,000,000	11½	36	24½	3,675,000
Twin City.	20,100,000	70¾	122¼	51½	10,351,500
United R. I., com.	19,400,000	12	98	86	16,684,000
United R. I., pfd.	15,000,000	20⅛	93½	73⅜	11,081,250
Total depreciation					$468,014,286

As before stated, the high prices of practically all the issues shown above were made in January of 1906. The high prices for the Inter.-Met. issues were made within the first few weeks in which they were traded in. Most of the low points shown above have been made during the last week. In addition to general market conditions there have been many things to help depress market values of the public utility securities. The passing of the 80-cent gas bill by the State Legislature had a greater effect on Consolidated Gas and Brooklyn Union Gas than did any other event on any security. The cutting of the Consolidated Gas dividend and the passing of the Brooklyn Union Gas dividend resulted from this legislation. The securities of these two companies have also suffered from the attacks of various officials and from the fear that the companies may be made subject to the inquisitorial terrors of the Public Service Commission. On the other hand, there is much in the display of public temper just now to indicate that corporation baiting will not be allowed to go much further.

CURRENT NEWS AND NOTES.

WIRELESS IN ALASKA.—We are indebted to Mr. Leon E. Harper, first class sergeant, U. S. Signal Corps, now at the wireless station, St. Michael, Alaska, for the following data in comment on an article in our columns last August: "It gives me great pleasure to state that the Signal Corps, U. S. A., are operating, and have been, since Aug. 17, 1904, a successful commercial wireless system between Safety Harbor and St. Michael, Alaska, a distance of 110 miles, handling from 100 to 150 messages and press daily without interruption or error. The system used is in greater part equipped with instruments devised by men of the Corps. Another year, with instruments now in use, will see a chain of wireless stations daily handling a large amount of business between Safety Harbor, St. Michael, Fairbanks, Circle and Valdez."

ENGLISH MUNICIPAL CRAZE.—A further reaction is noted in England against the violent socialistic, public-ownership craze of the past 25 years. A special cable dispatch from London, of Nov. 2, remarks that the fact that Socialism has not gained such a hold on British constituencies as the result of the last Parliamentary election led many persons to believe, has been shown in the municipal elections held in England and Wales last week. At the general elections the Socialists succeeded in electing members of Parliament principally in three-cornered fights with such success that both the great parties, the Liberals and the Conservatives, entered on a strenuous campaign against what they termed the "dangerous propaganda of the Socialists." This has resulted in the overwhelming defeat of the Socialists throughout the country, that party even losing many seats formerly held by it. To do this the Liberals and Conservatives, or Unionists, combined in some instances, but even where fusion was not resorted to the more conservative candidates were elected.

GEMS MADE BY RADIUM.—Further details are to hand of the work done in France by Prof. F. Bordas in transforming ordinary corundum or oxide aluminum crystals into rubies, emeralds, sapphires and topazes by the use of radium. The jeweler who sold Prof. Bordas the original corundums, valued at about 50 cents a carat, has appraised several of the transformed jewels at $100, and even $150 a carat. Some of them are exceedingly beautiful in brilliancy and color. Prof. Bordas decided to experiment with the hardest crystalline substances, and selected for the purposes of economy the cheapest form of corundums. Under the influence of a molecular bombardment produced by the emanations of bromure of radium the corundums underwent a remarkable change. The hitherto white crystal became to all appearances a topaz; blue corundum became an emerald; a green-pink one became a ruby, and a violet crystal a sapphire. By graduating the radio-active emanations the professor even secured a mixed gem, half sapphire and half topaz. When he submitted the newly created gems to the expert lapidary from whom he had purchased the original crystals the latter declared that it was impossible to distinguish his gems from natural ones. Prof Bordas, who is the Director of the Laboratory of the Ministry of Finance, repeated his experiments time and again before he finally reported the result of his researches to the Academy of Sciences, a small tray of radium-made gems being submitted to the scrutiny of the members of the learned body at the same time. These stones have been declared to be genuine.

INSPECTION TRIP OF CLASS.—Thirty-five members of the senior class in electrical engineering at the University of Illinois, accompanied by Prof. Morgan Brooks, professor of electrical engineering, are making an inspection trip through the East, the itinerary including Schenectady, New York and Pittsburg. The party attended the meeting of the A. I. E. E. Friday evening of this week.

CIVIL SERVICE EXAMINATION.—The New York State Civil Service Commission will hold examinations Nov. 30 for various positions, including that of electrical engineer of the Public Service Commissions. The salaries of these positions are $1,500 to $3,600. Further information with application forms may be obtained from the chief examiner of the commission at Albany, Mr. Charles S. Fowler.

A. I. E. E. MEETING.—As announced last week, the American Institute of Electrical Engineers will hold its two hundred and twenty-second meeting in the auditorium of the Engineering Societies Building, on Friday of this week, at 8:15 p. m., when Mr. A. H. Armstrong, of the General Electric Company, will read a paper entitled "Comparative Performance of Steam and Electric Locomotives." Several prominent engineers have been invited to participate in the discussion.

UNIVERSITY OF TORONTO.—The University of Toronto Engineering Society has decided to discontinue the publication of its annual transactions and to replace them by a regular publication issued monthly during the academic year. The standard will be maintained and raised. This monthly, it is stated, will have a guaranteed circulation of 1500 at the start, and this is to be increased to 2000 before the first volume is complete.

ILLUMINATING ENGINEERING SOCIETY.—The next meeting of the New York Section of the Illuminating Engineering Society will be held at the United Engineering Societies Building, 33 West Thirty-Ninth Street, Thursday evening, Nov. 14 at 8:15 o'clock. Mr. W. S. Andrews, of Schenectady, will present an illustrated lecture on "Pioneer Electric Lighting." This lecture will treat of the early development of the incandescent electric lamp and central station practice, and of the men associated with these early enterprises.

A GRAND RAPIDS CLUB.—An electrical educational club has been formed by the 50 or more employees of the Grand Rapids-Muskegon Power Company. A course of lectures on electrical subjects, extending over a period of six months, will be given at the company's office. The first was given Oct. 30 by F. E. Greenman on "Building and Operating Dams and Transmission Lines." Following this, twice a month, lectures will be given on the use of electric motors in factories, illuminating engineering, new methods of lighting, the latest ideas in electrical heating devices and kindred subjects. Discussions will follow the lectures.

STILL USING WAX CANDLES.—It is stated that the Earl of Mansfield has entered into a contract with the Hampstead (London) Council for the supply of electricity for lighting his mansion at Ken Wood, adjoining Hampstead Heath. The work of wiring and fitting is being proceeded with. In this case electric light takes directly the place of wax candles, as the successive Earls of Manchester have refused to use gas lighting, which accounts for the excellent preservation of the many art treasures in the mansion. In many of the famous old ancestral libraries, etc., of England it was found that gas could not be used on account of the quick rot that ruined the choice bindings.

TWENTY-FIVE YEARS OF THE INSTITUTE.—Before the Schenectady chapter of the American Institute of Electrical Engineers, Mr. T. C. Martin gave an address dealing with the history of the institute since the first steps were taken for its formation in 1883. Details were given of that formative period, and a number of points of general interest were touched upon by the lecturer, who has held every office in the Institute except that of treasurer, and who was president in 1887, being now, therefore, the senior survivor of the 19 who have occupied the chair. One interesting part of the address was that giving data as to the manner in which this the youngest of the four national engineering societies has already a considerable lead over the others in membership. Mr. D. B. Rushmore, chairman of the local section, presided.

ARC-LAMP IRON ELECTRODE.—A patent granted Oct. 29 to Richard Fleming describes an electrode for an arc lamp consisting of an iron tube filled with iron in a divided state, such as iron filings, cast-iron chips, or the like. It is stated that such an electrode possesses considerable mechanical advantages, and is easily and cheaply made. As an electrode for a luminous arc, it is but slowly consumed in operation, and the arc given thereby—of the flame or luminous type—possesses high illuminating powers. Another patent issued on the same date to the same inventor, but on application filed some months later (March 26, 1903), describes a similar electrode, but the iron tube is filled with magnetite. In both cases the electrode is intended for use as the lower electrode in an arc lamp.

NEW INSULATING MATERIAL.—A patent granted Oct. 29 to Robert Muller, of Munich, Germany, describes an insulating material which is claimed to be fireproof and to have a high specific resistance sufficiently near to rubber or porcelain to make it satisfactory for use in the electric art. Although pitch is one of its constituents, it is stated that the material is so non-inflammable that it may be subjected temporarily to an electric arc without being burned up and without being softened. The process for making the material consists in combining intimately a fire resistant material, such as asbestos in a comminuted state, with a bituminous material, such as mineral pitch, dissolved in a suitable solvent, such as benzol, and so proportioned that a consistent, plastic mass is formed, which is then subjected to heavy pressure, preferably in a cold state, and dried by the evaporation of the solvent. The proportions of the several constituents mentioned is 100 parts of mineral pitch dissolved in 20 parts, by weight, of a volatile solvent; from 25 to 75 parts of the solution is used with 100 parts of asbestos.

AN ELECTRIFIED MATTERHORN.—It is stated that English mountain climbers and other selfish admirers of Alpine scenery have taken up the protest made by many Swiss against the building of an electric railway on the Matterhorn. Sir Martin Conway, the well-known explorer, presided recently at a meeting of the English branch of the Swiss League for the Preservation of Picturesque Switzerland. Here a protest to the Swiss Federal Council against the projected railway was drawn up. The Bishop of Bristol, representing the Alpine Club said that, in the eyes of all to whom sublimity of nature appeals, the projected railway would act as a profanation and that the sacrifice of such a mountain as the Matterhorn to sectional interests and to the materialization of the age, would involve an irreparable loss to humanity and a wrong to succeeding generations. The matter will shortly come up before the Swiss Parliament. Meantime work on the Jungfrau Railway is proceeding at such a pace that non-climbers who visit the Alps may expect to find it in operation to the summit within two years. It is just 10 years since the building of the Jungfrau Railway was begun, and it is now complete to Jungfraujoch, which has an altitude of 11,200 ft. About 2300 ft. more of altitude remain to be surmounted. The necessary roadway for 2000 ft. of this altitude will be placed in the open, but for the last 300 ft. the engineers have planned an elevator which will be operated through the heart of the mountain. Thus invalids and others who cannot climb the higher Alps are enabled to enjoy the beauties that hitherto have been the exclusive possession of people with strong legs.

A FRATERNAL KISS.—Sarah Bernhart uttered a pretty sentiment when sending a wireless message across the sea, she made it read: "This fraternal kiss of Europe and America across space is the most poetic manifestation of science."

TELEPHONE APPARATUS.—At the October convention of the Pennsylvania State Independent Telephone Association resolutions were adopted unanimously not to use Bell apparatus and to expel any member company purchasing, using or connecting such apparatus. The cause of this is the recent action in placing Bell telephones freely on sale to every comer.

THREE NAMES.—In noting the success of commercial wireless telegraphy, the *Wall Street Journal* names Morse, Field and Marconi in connection with their great work in land and submarine and wireless systems, and says: "The three names identified with this less than half a century of progress deserve to be kept in memory as among those who have done most to contribute to the welfare of mankind by the shrinkage of distances through improved means of communication."

ENGINEERING LIBRARY OPEN EVENINGS.—On and after Wednesday, Nov. 6, 1907, the reference libraries of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, and the American Institute of Mining Engineers, at 29 West Thirty-Ninth Street, New York, will be open evenings until 9 o'clock on all week days except public holidays. These libraries, constituting practically one library of engineering, are available to members of the above-named societies, engineers and the public generally, subject to proper regulations. Strangers are requested to bring letters of introduction from members or to secure cards from the secretaries of the respective societies.

TELEGRAPHS IN PERU.—U. S. Consul C. C. Eberhardt, of Iquitos, reports that a contract has been approved with a German company for the extension of the wireless telegraph system from Masisea to Iquitos. The operator of the station at Masisea states that the supplies are now being shipped from Europe for this extension. He also says that the company is greatly elated over the success of the system between Puerto Bermudez and Masisea, the first of its kind, members of the company assert, that has been successful in overcoming such distances under difficulties of forest and mountain, though various other attempts have been made in tropical South America and in the Kongo districts.

THE TECHNICAL PUBLICITY ASSOCIATION, of New York, devoted its meeting of Oct. 31, to "The Mailing List" in securing foreign business. The discussion, introduced by F. F. Coleman, advertising manager of the Lidgerwood Manufacturing Company, became general. Mr. Steven de Csesznak, of the *American Exporter,* gave an address on the subject. The following were elected to membership: Randolph T. Ode, Providence Engineering Works; C. Dickens Sternfels, Standard Roller Bearing Company; J. Mason Knox, General Electric Company; L. D. Gibbs, Boston Edison Electric Illuminating Company; Walter S. Rogers, Crane Company; H. S. Snyder, Joseph Dixon Crucible Company. It was announced at this meeting that organizations modeled on the Technical Publicity Association are being started in Chicago and in London.

ELECTRICALLY DRIVEN OCEAN LINERS.—A special cable message from London states that experiments are now being conducted with the object of providing an electrical connecting link between the low-speed propeller shaft and the steam turbine which operates to best advantage when the speed is high. The turbines are to be direct connected to either direct-current or alternating-current generators and the propellers are to be similarly connected to corresponding electric motors. Among the advantages claimed for the "electrical gearing" are flexibility in placing the various machines to best advantage and designing each for its specific duty, ability to reverse the propellers at will, and to control the whole movement of the ship from the polit-house. It is claimed that a speed of 30 knots per hour can be obtained with the electrical equipment.

ZONE TROLLEY FARES.—A rather sharp criticism is made by *Concerning Municipal Ownership* in its November issue as follows: "Mayor Johnson, of Cleveland, when put on the witness stand recently was forced to admit that his much-advertised low-fare scheme would not supply transportation equivalent to that now being given by the Cleveland Electric Railway Company, since it would be operative only within the city limits. Inasmuch as a large part of the passengers now carried reside in the suburbs, and as under his plan they would have to pay two fares, the 'low-fare' proposition would be an expensive arrangement for them. Shorn of the glamour of Johnsonism, the plan practically involves a change from the American 'one ride, one fare' principle to the zone system which has so effectually restricted traction development in Europe. The serious objection to this method is that it tends to keep population crowded within the limits of the inner zones, and thus to perpetuate the tenement evil. In doing anything to restrict the movement to the suburbs, Mayor Johnson is showing himself an enemy to the health and morals of his city. But what do they count when political power is at stake!"

REBUILDING SAN FRANCISCO.—Mrs. Gertrude Atherton, in the course of her noteworthy article in the current *Harper's Weekly* entitled "San Francisco and Her Foes," gives, incidentally, some surprising figures showing the remarkable and little-realized extent to which the stricken city has been rebuilt—and rebuilt, says Mrs. Atherton, in such a way that its appearance is in many places greatly improved. These are the exact figures: Up to August 1st, 1907, San Francisco building permits since the fire amounted to $79,152,447. The number of Class A buildings erected are 47, costing $11,969,500; Class B buildings, 76, costing $5,953,050; Class C buildings, 941, costing $26,716,319. Frame structures, complying with building laws and classed as permanent, 2191, costing $28,072,475. For repairs and alterations, including permits for rehabilitation of Class A buildings damaged by the fire, $6,441,112. To this estimated cost must be added fifteen per cent, as actual costs are proven to be that much higher than the architect's estimates. Of this expenditure labor has received forty-five per cent—$35,618,590. During the two years following the Baltimore fire building permits in that city amounted to $28,000,000. During one year following the San Francisco fire building permits have amounted to $60,169,923. This new work has involved, of course, an immense amount of new electrical interior work, some of which has been noted in these columns.

OVER-CAPITALIZATION.—Discussing the subject of trusts before the recent special convention of the National Civic Federation in Chicago, Mr. Isaac N. Seligman said: "The question of capitalization in the case of the trust is one that primarily affects the investing public. Entirely too much, in my opinion, has been made of over-capitalization of industrial enterprises. So far as the control of capitalization is intended to safeguard the investor I can only record my conviction that the judgment of the market invariably discounts the nominal capitalization of the company. If this capitalization is larger than the facts warrant the securities sell at a discount; if smaller, they sell at a premium. The actual basis of such market valuation is not the par value, nor yet the actual assets of the company, but it is in every case earning capacity. The anti-trust policy should not proceed faster than is compatible with public welfare. The investing public have too much interest in such securities, and the shock to business interests is too violent. The law should be so modified as to reach only those who have really committed a crime against the well-considered interest of the community as a whole. The attempt vigorously to enforce a law which is based upon erroneous premises is bound not only to fail, but in the meantime to create havoc."

Steam-Driven Transmission Stations of the Societa Lombarda, of Milan, Italy.

IN June, 1900, the Società Lombarda opened its first hydro-electric power house at Vizzola Ticino, Italy, and succeeded in loading it to its maximum capacity in a little more than three years. From this power house electrical energy is supplied directly to about 110 consumers, 20 of whom redistribute the energy for lighting and small motor loads, they having obtained rights from the Società Lombarda to sell energy in certain districts.

The rated capacity of the Vizzola Ticino station is 12,000 kilowatts. Electrical energy from it is distributed over a network more than 125 miles long, to which are connected about 700 electric motors and 30,000 incandescent lamps. The territory covered includes 40 towns, and there are in all about 2000 consumers connected to the line.

The principal large centers of energy consumption are Legnano, Busto-Arsizio and Gallarate. In these communities, and in some of their suburbs, the cotton industry alone requires more than 12,000 horse-power, or two-thirds of the maximum capacity of the Vizzola station.

It was readily apparent, therefore, that the demands for electrical energy would soon surpass the output of the station at Vizzola, and the Società Lombarda, in 1901, decided to construct a second hydro-electric station at Turbigo, 7.5 miles further down the valley on the banks of the Ticino River, where 5000 horse-power could be developed; the water being taken from the canal of Naviglio Grande. This power house is now finished, and in regular operation; and before the end of the present year arrangements will be completed for transmitting energy from this station to all parts of the network now fed from the Vizzola station.

At the time of the construction of the Turbigo hydro-electric station it was foreseen that the demand for electricity would become so great before the completion of the plant as to exceed the rated capacity of the station of Vizzola and would require the continuous operation of the reserve units. Accordingly, the company decided to build a steam-driven electric station, which would act as a supplement and reserve to the hydro-electric stations.

The first units installed in the steam-driven station have an aggregate rating of 5400 horse-power, which is equal to the maximum rating of the new station at Turbigo; the idea being that the steam station could carry the entire load of the new station in case of delay in construction.

The steam-driven station is situated at Castellanza, which is an important center of energy consumption. This location was chosen for the following reasons: It could easily be connected to the transmission system; it was not far from the hydro-electric stations, in conjunction with which it was to operate; there is ample and suitable supply of water for condensing purposes; and it is near two railway lines, the Milano-Gallarate and the Novara-Seregno, over which the coal can be economically supplied.

The work of construction on the steam station was commenced in May, 1903, and in little over a year the station was put in operation. The masonry work was done by the Brambilla Company; the steam machinery was supplied by Franco Tosi, of Legnano, and the electric machinery by Brown, Boveri & Company, of Baden. The first units installed consist of two horizontal triple-expansion steam engines directly coupled to three-phase alternators; each unit rated at 2700 horse-power. The frames of the engines are of the bayonet type, cast in one piece with the crank bearings. There are two low-pressure cylinders, one being placed in tandem with the high-pressure cylinder, the other in tandem with the intermediate-pressure cylinder. The cranks are displaced 90 deg. from one another on the driving shaft. Each cylinder is equipped with two admission and two discharge valves; the high-pressure cylinder valves being controlled by a Porter governor, which can vary the cut-off from 0 to 60 per cent. The governor is arranged to permit the adjustment of speed by hand for use when paralleling the alternators. Forced lubrication is used for the cylinders, the crank-pin and all working parts of both engines being supplied with oil from a common reservoir.

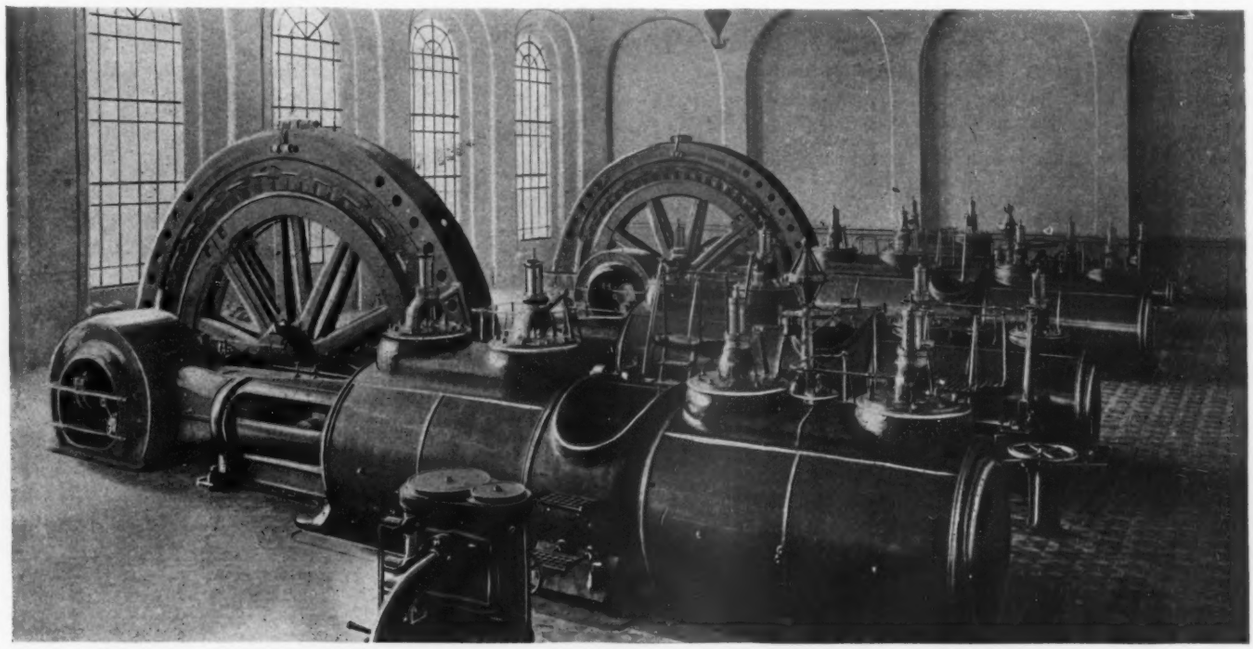


FIG. I.—STEAM-DRIVEN ALTERNATORS IN THE CASTELLANZA POWER HOUSE.

The power, guaranteed efficiency, and steam consumption, the engine operating condensing with superheated steam having a temperature between 250 deg. and 280 deg. C., and having an initial pressure of 180 lbs., are as follows:

Cut-off in the high-pressure cylinder, per cent	13	19	25	30	44
Net horse-power	1100	1480	1750	2000	2700
Efficiency, per cent	83	86	87.5	88.5	90
Steam consumption (superheated), pounds per i. hp-hr.	10.14	9.81	9.48	9.92	10.80

The alternators are of the revolving-field, solid-pole type, rated at 2400 kilovolt-amperes (1920 kilowatts for power-

factor = 0.8). The normal speed of 107 r. p. m. corresponds to a frequency of 50 cycles per second. The normal e. m. f. is 10,500 volts between phases. The weight of the rotating part is 40 tons.

The guaranteed efficiency and regulation are as follows:

Full normal load of 1920 kw and unity power-factor efficiency =	95	Per Cent
Full normal load of 1920 kw and power-factor of 0.8 efficiency =	93.5	"
Half load of 960 kw and unity power-factor efficiency =	93.5	"
Half load of 960 kw and power-factor of 0.8 efficiency =	92	"
Drop of potential from no load to full non-inductive load (1920 kw), excitation and speed remaining constant	9	"
Drop of potential from no load to full load (1920 kw). excitation and speed remaining constant for power-factor = 0.8	23	"

The alternators are separately excited by means of two independent exciters, one of the groups being driven by a small tandem-compound steam engine running at 375 r. p. m., and the other being driven by an electric motor.

Steam is furnished to the two prime movers by six water-tube boilers constructed for an effective pressure of 195 lbs., each having a heating surface of 3175 sq. ft. The aggregate heating surface of the plant being 19,050 sq. ft., and the superheating surface being 3875 sq. ft. A battery of 16 economizers, having a heating surface of 5186 sq. ft., is installed for heating the feed-water.

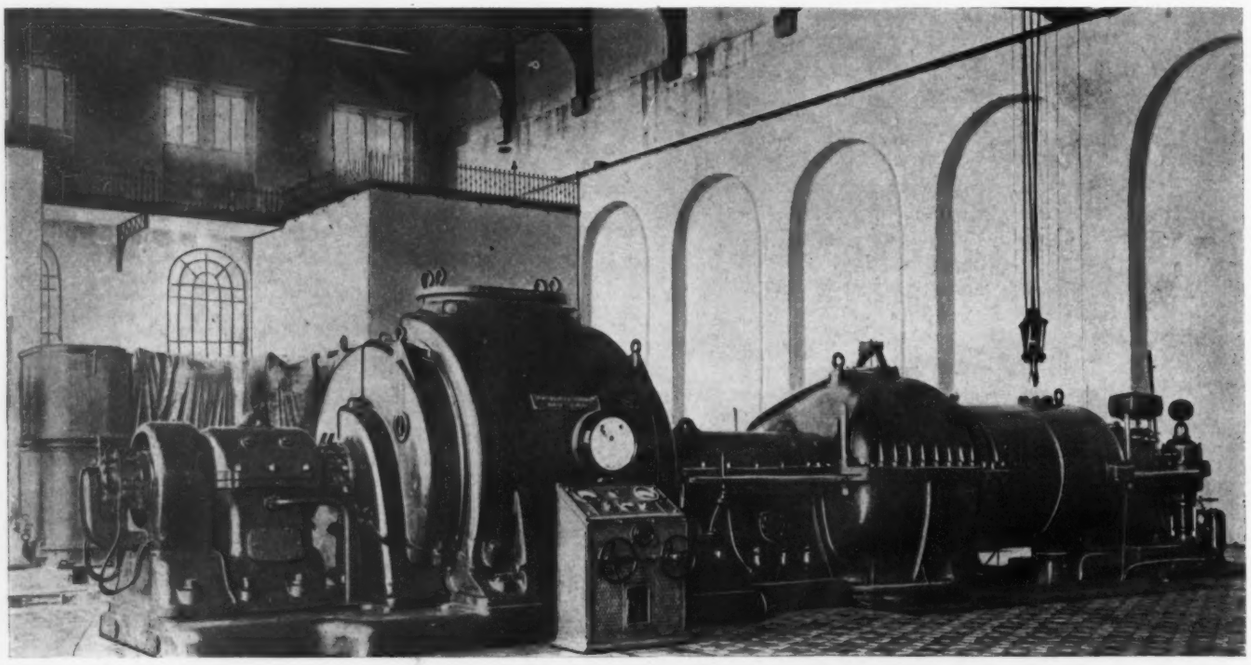


FIG. 2.—ONE OF THE 5000-KW TURBO-ALTERNATORS IN THE CASTELLANZA POWER HOUSE.

The boiler feed-water is forced by two electrically-driven pumps from a well into a large cement tank placed under the floor of the boiler room. From this tank, the feed pumps, three in number, two driven by electricity and one by steam, deliver it to the boilers. For condensing purposes, a specially constructed canal from the Olona River conducts water from the river into a large tank directly under the condensers, where it is mixed with condensed steam and returned to the river at a point further down the stream.

The exciter motors, the lamps, the motor for the traveling crane, the motors driving the feed-water pumps, the motors operating the automatic cleaners of the economizers, the coal and ash conveyors, the repair shop, etc., are all supplied with electricity either from the station itself or from the hydro-electric plants at Vizzola and Turbigo.

A small Tudor storage battery is placed under the switchboard to secure continuity of excitation and illumination. The battery is large enough to supply electricity for excitation and for illumination for an hour.

The switchboards are arranged so that the alternators can be operated either independently of those in the hydro-electric plants, or in parallel with those in one or both of the hydro-electric stations. Experience has shown that the three plants can be operated very successfully in parallel; the steam station being used to supply the peak loads of the hydraulic stations, thus permitting the latter to work continuously at their maximum capacity.

In June, 1904, a company was organized at Basilea for the development of certain important concessions of hydraulic power given to the Swiss towns of Poschiavo and Brusio, in the Canton of Grigioni. The principal promoters of this company are the Società Lombarda and Alioth Company, machine builders, in Basilea. The capital was supplied from Swiss, Italian and English sources.

The most important concession was the first to be developed. This concession is on the Poschiavino River, near the Italian frontier, between the town of Campocologno and the valley Tirano, where 20,000 horse-power can be obtained with a head of 1312 ft. The continuity of flow is assured by the Lake Poschiavo, which is located above the falls.

The Società Lombarda acquired a lease covering a period of years from the Brusio Company for the purchase of the output of the first station, and, in addition to this, it secured an option on the major portion of the energy which the Brusio Company could supply in the future when other concessions were developed.

The energy obtained from the Brusio Company's first plant was to be used to supply the increase of business in the neighborhood of Busto, Legnano, Gallarate and Saronno, where a market for the energy from Vizzola and Turbigo had rapidly been built up. The rest of the energy was to be distributed to a network in the neighborhood of Como, which is a large industrial center.

The plant for developing and transmitting electricity was begun a little before the end of 1904, and is now nearly finished; the companies expect to begin operation at about the end of this year. The transmission line is 100 miles long, and is one of the largest Italian systems that develop electricity in the Alps and transmit it to a long distance.

During the construction of the hydro-electric plant on the Poschiavo River, the Società Lombarda was confronted by the same conditions as existed during the construction of the plant at Turbigo, and resorted to the same methods of meeting them, namely, by the construction of a steam-driven electric station.

This new steam station is an extension to the old station at Castellanza; the new units consisting of turbo-alternators of the Brown, Boveri-Parsons type. One 5000 kilowatt unit was installed immediately to take care of the most urgent needs, and later a second and equal unit will be installed, which, together with the first, would constitute a complete reserve for the Brusio system.

Castellanza being one of the most important distribution centers, it was decided to construct a transformer sub-station at the steam power house at the same time that the other additions were being made. A second transformer sub-station was constructed at Lamazzo, from which center the Lombarda Company expects to develop a large business in the Comense region.

The sub-station is equipped with seven 50-cycle, 1250-kva single-phase transformers, reducing the e. m. f. from 35,000 volts to 11,000 volts. The guaranteed efficiency of the apparatus is 97.5 per cent, and the regulation, at a full inductive load, 3 per cent. Six of the transformers are in continuous service, the seventh being held in reserve. The six transformers are connected in two groups, each group being connected in star, thus forming two three-phase transformer groups, each group having a rating of 3750 kilovolt-amperes.

The turbo-units were built by Franco Tosi, of Legnano, and

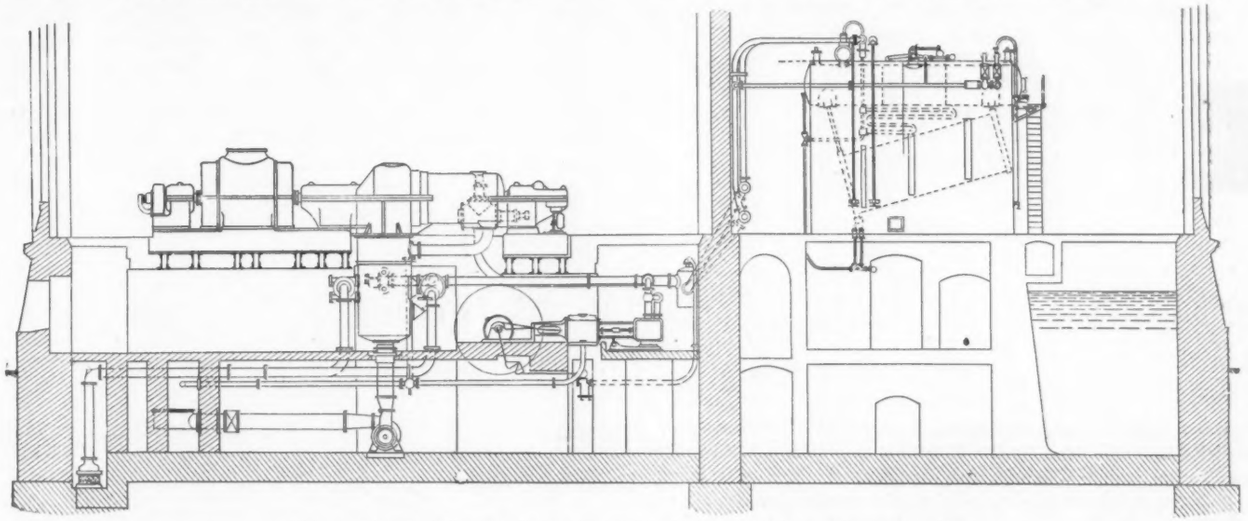


FIG. 3.—PARTIAL CROSS-SECTIONAL VIEW OF CASTELLANZA POWER HOUSE.

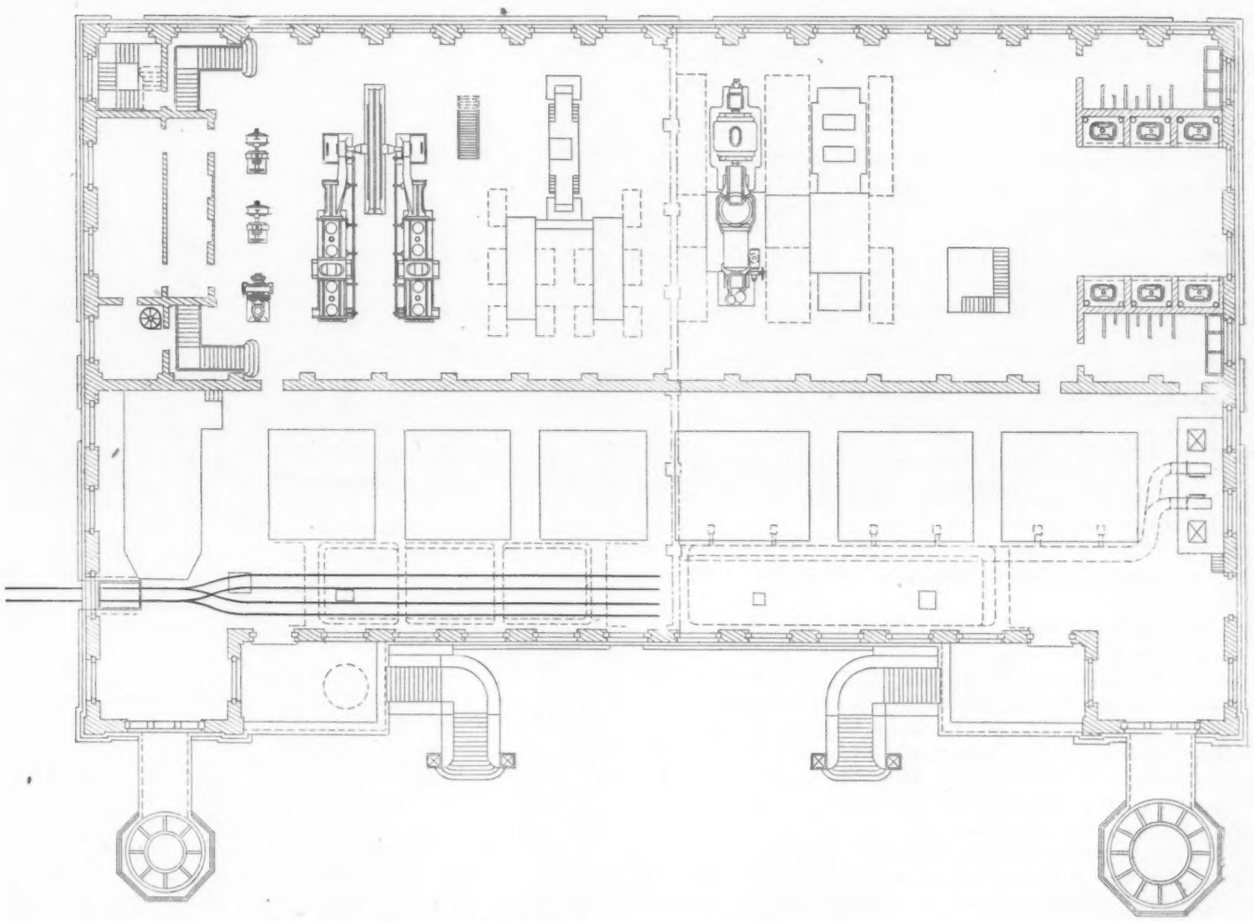


FIG. 4.—PLAN VIEW OF CASTELLANZA POWER HOUSE.

each is rated at 5000 kilowatts at a power-factor of 0.8 when operating with superheated steam at 275 deg. C., and at a speed of 1000 r. p. m. Each unit has its own direct-connected exciter and its own condenser, which is of the partial barometric type equipped with a centrifugal pump and an air pump. The guaranteed steam consumption when operating with superheated steam at 275 deg. C. and a pressure of 180 lbs. condensing with water at about 16 deg. C., is:

Load, kw	5000	4000	2000	1000
Steam consumption, kg. per kw-hr....	6.90	7.20	8.60	11.10
" " lbs. per kw-hr....	15.18	15.84	18.92	24.42
*Coal consumption, kg. per kw-hr....	0.79	0.825	0.905	1.27
" " lbs. per kw-hr....	1.738	1.925	2.167	2.794

The condenser system is of a type patented by Franco Tosi. The steam is condensed by a spray of cold water; the condenser water being removed by a centrifugal pump placed directly below the condensing chamber. The column of water over the pump serves to regulate the load on the pump by varying the static head, the speed remaining constant. A check valve is placed in the exhaust pipe to prevent the return of water to the condenser in case of the stoppage of the centrifugal pump. In case of an accident to the centrifugal pump which would prevent the removal of the condensed steam, provision is made to stop the turbine and shut off the supply of injection water. The devices for doing this are operated by a float located in the lower part of the condensing chamber.

The moist air is removed from the condenser by an air pump of the Tosi vertical, compound, twin-cylinder type, the cylinders of which are cooled by water jackets. The two pumps of one turbo unit are driven by a 120-hp steam engine; those of the other unit being driven by three-phase motors operating at 500 volts, which is the potential of the distribution system.

The number of boilers was increased by the addition of six water-tube boilers built by Franco Tosi, of Lagnano. These boilers have an aggregate heating surface of 5920 sq. ft., and a superheating surface of 1615 sq. ft., and are built to operate at 190 lbs. The furnaces are fitted with automatic stokers of the underfeed type arranged to burn Cardiff coal.

The Società Lombarda has lately placed orders for delivery within this year of two turbo-generators, each rated at 2500 kilowatts, and operating at 1500 r. p. m.

*Cardiff coal.

Self-Inductance of a Solenoid of Any Number of Layers.

By Louis Cohen.

The only formula now available for the calculation of the self-inductance of a long coil or solenoid of more than one layer is that of Maxwell, which is as follows:

$$L = \frac{4}{3}\pi^2 n^4 l (x-y)(x^3-y^3) \qquad (1)$$

where l is the length of the solenoid, n is the number of turns per unit length, x and y are the external and internal radius of the solenoid. This formula, however, was developed on the assumption of a uniform field within the coil, which means that the end effects can be neglected. The assumption may lead to an error as great as 12 per cent, as I shall show later, even in the case of a comparatively long solenoid, with a length ten times the radius. It is quite evident that such a formula is not of very great value where accurate results are desired. It is, however, a very simple and convenient formula for numerical computations and is useful when only a rough approximation is desired.

The formula given below for the self-inductance of a solenoid of any number of layers will give results accurate to within one-half of a per cent even for short solenoids, where the length is only twice the diameter, the accuracy increasing as the length increases.

For most practical purposes this degree of accuracy is amply sufficient.

The formula is as follows*:

$$L = 4\pi^2 n^2 m\left\{\frac{2a_0^4 + a_0^2 l^2}{\sqrt{4a_0^2 + l^2}} - \frac{8a_0^3}{3\pi}\right\} + 8\pi^2 n^2$$
$$\left\{\left[(m-1)\,a_1^2 + (m-2)\,a_2^2 + \ldots\ldots\right]\left[\sqrt{a_1^2 + l^2} - \frac{7}{8}a_1\right]\right.$$
$$+ \tfrac{1}{2}[m(m-1)\,a_1^2 + (m-1)(m-2)\,a_2^2 + (m-2)(m-3)a_3^2 + \ldots]$$
$$\left.\left[\frac{a_1 \delta a}{\sqrt{a_1^2 + l^2}} - \delta_a\right]\right\} \qquad (2)$$

Where

m is the number of layers

a_0 is the mean radius of the solenoid

$a_1, a_2, a_3, \ldots a_m$ are the mean radii of the various layers

l is the length of the solenoid

δa is the radial distance between two consecutive layers

n is the number of turns per unit length.

For a long solenoid where the length is about four times the diameter, the above formula will reduce to the following:

$$L = 4\pi^2 n^2 m\left\{\frac{2a_0^4 + a_0^2 l^2}{\sqrt{4a_0^2 + l^2}} - \frac{8a_0^3}{3\pi}\right\} + 8\pi^2 n^2$$
$$\left\{\left[(m-1)\,a_1^2 + (m-2)\,a_2^2 + \ldots\ldots\right]\left[\sqrt{a_1^2 + l^2} - \frac{7}{8}a_1\right]\right\} \qquad (3)$$

The formulæ as given by equations (2) and (3) are very simple and convenient for numerical computations.

Below are two numerical examples to show the per cent error that Maxwell's formula (1) will introduce.

Example (1)

$a_1 = 5\ cm$, $\delta a = 0.1\ cm$, $m = 4$, $a_0 = 5.15\ cm$, $l = 50$

Introducing these values in (2) we get

$$L = 4\pi^2 n^2 \times 18{,}926\ cm.$$

The same example calculated by Maxwell's formula gives

$$L = 4\pi^2 n^2 \times 21{,}228\ cm.$$

The error is a little over 12 per cent.

Example (2)

$a_1 = 5\ cm$, $\delta a = 0.2\ cm$, $a_0 = 5.4\ cm$, $m = 5$, $l = 20\ cm$.

By formula (2) we get:

$$L = 4\pi^2 n^2 \times 10{,}888\ cm.$$

By Maxwell's formula we get for this case

$$L = 4\pi^2 n^2 \times 14{,}622\ cm.$$

The error in formula (1) is, therefore, about 35 per cent.

In the development of formula (2) I have incidentally obtained a very simple and convenient formula for the calculation of the self-inductance of a single-layer solenoid, which is as follows:

$$L = 4\pi^2 n^2\left\{\frac{2a^4 + a^2 l^2}{\sqrt{4a^2 + l^2}} - \frac{8}{3} - \frac{a^3}{\pi}\right\} \qquad (4)$$

where a is the mean radius and l is the length of the solenoid.

*The complete paper where the mathematical development of the formula is given will be published shortly in the *Bulletin* of the Bureau of Standards.

Lighting by Electricity and Gas.

An abstract of a report presented by H. Harrison to the (British) Municipal Electrical Association and based on returns from various lighting plants in 150 towns is given in *Electrical Engineering*, London. The total candle-power of gas lighting in these 150 towns was 10,136,000, while the total candle-power of electric lighting in the same towns was 11,024,500. The average cost per cp-year in these 150 towns was 32.8 cents for gas and 14.8 cents for electric light.

Distribution and Breadth Coefficients of Alternators.

BY N. STAHL.

THE formula ordinarily stated for the electromotive force of alternators is derived by the aid of three assumptions, as follows: (a) that the distribution of magnetic flux follows the Law of Sines, (b) that the conductors are not distributed, that is, every conductor on one side of a coil occupies the same position relative to the flux, (c) that the coil subtends the whole pole pitch.

This formula may be written,

$$E = 2.22\,NfZ \times 10^{-8} \text{ volts, where}$$

E is the effective e. m. f. between collecting rings,

N is the maximum value of the pole flux in c. g. s. lines of force,

f is the frequency, and

Z the number of conductors joined in series.

In so far as the above assumptions are not borne out in actual machines, the formula will require readjustment by the insertion of factors representing the ratios of the actually generated electromotive forces to those hypothecated.

In many machines, by a proper shaping of the polefaces a flux curve is obtained which is very closely sinusoidal. This is largely empirical work, aided of course, by due considerations of the permeability of the particular magnetic material, the ratio of pole-span to pole-pitch and the reluctance of the entire magnetic circuit. Where the flux curve departs from the sine law, it would be necessary to know its analytical equation in order to derive a rational formula for the electromotive force.

Since, on the assumption of equal pole strengths and flux-distributions, the flux must necessarily be periodic, it will always be possible to express the equation for any flux curve, by Fourier's theorem, as a series of sine and cosine terms of odd order.

The terms of even order do not occur since the flux distribution around any N-pole is the exact reverse of that around a S-pole, and therefore the flux curve is symmetrical with respect to half-periods. Where, as is usually the case for alternators on full load, there is distortion of the flux, producing asymmetry in the first and second quadrants, cosine terms would enter into the Fourier's series.

The complication so introduced is, however, merely tedious, as each of the harmonics would be treated in the same way as the fundamental for the effective electromotive force when the flux is sinusoidal. In what follows, however, we shall assume that the law of sines obtains for the magnetic flux.

When the conductors are equally spaced around the periphery or distributed for any coil in several slots, it is obvious that the instantaneous electromotive forces in the several conductors of one side of any coil will be different; the total for that half-coil may, as is well known, be found by the vectorial addition of the separate electromotive forces.

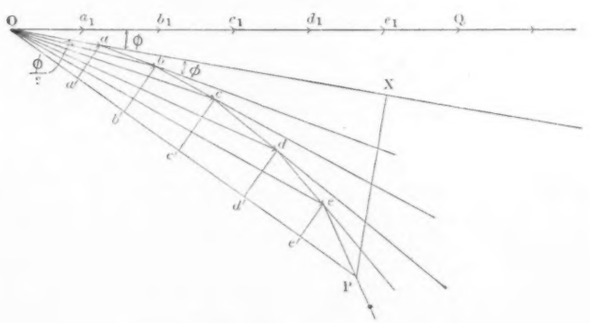


FIG. 1.—ELECTROMOTIVE FORCE VECTORS.

In Fig. 1, let $Oa\ (=e)$ be the maximum e. m. f. generated in any conductor, in direction and magnitude. Then ab will represent the e. m. f. of the next consecutive conductor, differing in phase from Oa by the angle ϕ, where $\phi = \frac{\pi}{l}$ radians, l being the number of equally spaced conductors in any polepitch.

Let n be the number of conductors in any half-coil; then OP will be their resultant e. m. f. Were they all generating the same electromotive force at the same instant, their resultant would be $OQ = ne$. To obtain the actual e. m. f. generated, we shall need to multiply our coefficient 2.2 by some factor, k_d, which represents the ratio of $\frac{OP}{OQ}$. The angle aOb is obviously $\frac{\phi}{2}$, and similarly for bOc, cOd, etc.

Now, $OP = OX \sec (n-1)\frac{\phi}{2}$

but $OX = e\cos 0.\phi + e\cos\phi + e\cos 2\phi + \cdots e\cos(n-1)\phi$

$$= e\sum_{s=0}^{s=n-1}\cos s.\phi$$

and $$OP = e\sec(n-1)\frac{\phi}{2}\sum_{s=0}^{s=n-1}\cos s.\phi$$

$$k_d = \frac{\sec(n-1)\frac{\phi}{2}\sum_{s=0}^{s=n-1}\cos s.\phi}{n} \qquad (A)$$

The value of k_d may be obtained in another and rather simpler form for computation, by projecting Oa, Ob, etc., directly upon OP.

$$OP = e\cos(n-1)\frac{\phi}{2} + e\cos\left[(n-1)\frac{\phi}{2} - \phi\right] + \cdots + e\cos\left[(n-1)\frac{\phi}{2} - (n-1)\phi\right]$$

$$= e\left[\cos(n-1)\frac{\phi}{2} + \cos(n-3)\frac{\phi}{2} + \cdots + \cos(3-n)\frac{\phi}{2} + \cos(1-n)\frac{\phi}{2}\right]$$

$$\cos(n-1)\frac{\phi}{2} + \cos(n-3)\frac{\phi}{2} + \cdots + \cos(3-n)\frac{\phi}{2} + \cos(1-n)\frac{\phi}{2}$$

Whence $$k_d = \frac{\sum_{s=n-1}^{s=1-n}\cos s.\frac{\phi}{2}}{n} \qquad (B)$$

Thus, with a sinusoidal flux, and coils spanning a pole-ditch, we may write

$$E = 2.22\,k_d\,NfZ \times 10^{-8} \text{ volts.}$$

When the coil-span is only a fraction of the pole-pitch, we have the condition represented in Fig. 2, for maximum flux through any loop consisting of two conductors. $\frac{\theta}{2}$ represents, in electrical radians, half the angle by which the coil-span fails of the pole-pitch.

Both sides of the loop being in equal flux regions, the electromotive forces generated in them annul each other, but completely so, for this position only, in any polar region. For other positions, the effect of the partial annulments on the e. m. f. generated may be seen by integrating, for each side of the loop, through half a cycle.

Let N_θ be the instantaneous value of the flux; then

$$N_\theta = N \cos \Theta \text{ and } e = -\frac{dN_\theta}{dt} = N \sin \Theta . d\Theta$$

Now, assume that the right side of the loop is at the position of zero flux; the angular displacement of the left side from it

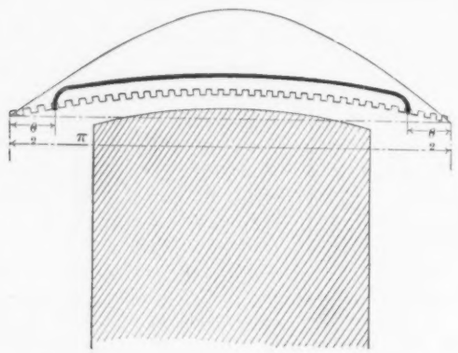


FIG. 2.—FRACTIONAL POLE-PITCH WINDING.

will be $\pi - \Theta$. While the loop moves through the angle $\frac{\Theta}{2}$, the average e. m. f. generated will be

$$e' = \frac{1}{\frac{\Theta}{2}} \int_0^{\frac{\Theta}{2}} N \sin \Theta . d\Theta - \frac{1}{\frac{\Theta}{2}} \int_{\pi-\Theta}^{\pi-\frac{\Theta}{2}} N \sin \Theta . d\Theta$$

$$= \frac{2N}{\Theta}\left(1 - \cos\Theta - 2\cos\frac{\Theta}{2}\right)$$

During the passage through the next angle $\frac{\Theta}{2}$, the average e. m. f. would be

$$e'' = \frac{1}{\frac{\Theta}{2}} \int_{\frac{\Theta}{2}}^{\Theta} N \sin \Theta . d\Theta - \frac{1}{\frac{\Theta}{2}} \int_{\pi-\frac{\Theta}{2}}^{\pi} N \sin \Theta . d\Theta$$

$$= -\frac{2N}{\Theta}\left(1 - \cos\Theta - 2\cos\frac{\Theta}{2}\right)$$

Thus the average for the periods of partial annulment is $\frac{e' + e''}{2} = 0$, and the only part of the flux effective in producing the resultant e. m. f. of the machine lies between $\frac{\Theta}{2}$ and $\pi - \frac{\Theta}{2}$.

This average e. m. f. becomes, since now both sides aid each other,

$$e_a = \frac{2}{\pi} \int_{\frac{\Theta}{2}}^{\pi-\frac{\Theta}{2}} N \sin \Theta . d\Theta = \frac{4N}{\pi} \int_{\frac{\Theta}{2}}^{\frac{\pi}{2}} \sin \Theta . d\Theta = \frac{4N}{\pi} \cos \frac{\Theta}{2}$$

If the coil spanned a whole pole-pitch, we should have

$$e'_a = \frac{2N}{\pi} \int_0^{\pi} \sin \Theta . d\Theta = \frac{4N}{\pi} \int_0^{\frac{\pi}{2}} \sin \Theta . d\Theta = \frac{4N}{\pi}$$

The actual e. m. f. stands to the assumed in the ratio of $\frac{e_a}{e'_a} = \cos \frac{\Theta}{2}$. Call this ratio k_b.

Thus where all the loops have the same breadth, the formula would read, $E = 2.22\, k_c k_b N f Z \times 10^{-8}$ volts.

Where each coil is composed of several loops having different breadths, the coefficients for the several loops, beginning with the outer, run as follows, $k'_b = \cos \frac{\Theta}{2}$; $k''_b = \cos \frac{3\Theta}{2}$ - - - - $k_b^n = \cos (2n-1)\frac{\Theta}{2}$, and the resultant coefficient, k_b^r, is

$$k_b^r = \frac{k' + k'' + - - - + k^n}{n} =$$

$$\frac{\cos \frac{\Theta}{2} + \cos \frac{3\Theta}{2} + - - - + \cos (2n-1)\frac{\Theta}{2}}{n} =$$

$$\sum_{S=1}^{S=2n-1} \frac{\cos S . \frac{\Theta}{2}}{n}$$

Where the conductors are arranged singly in slots, it is evident that $\Theta = \phi$, and the complete formula may be written,

$$E = 2.22 \sum_{S=1-n}^{S=n-1} \cos S \frac{\Theta}{2} \times \sum_{S=1}^{S=2n-1} \cos S \frac{\Theta}{2} N f Z \text{ volts.}$$

$$n^2 \times 10^8$$

Even where several conductors to be joined in series are laid in the same slot, the above formula may be used for all practical purposes, though for extreme accuracy the above methods may be extended to any cases, however complicated.

It is to be observed that if n is defined as the number of conductors per pole per phase, the above reasoning is not invalidated; the formula applies to any number of phases, E being the e. m. f. generated in any single circuit through the armature, for any one phase, and Z is the number of conductors in that circuit, the different values of the angle ϕ for different phases causing the variation in the values of the coefficients.

Polyphase alternators are often "coil-wound," with the turns of a single coil distributed in several slots, so that the current in traversing the coil spirals in or out through the successive loops, some of which then span more than a pole pitch. By an integration analogous to that given for the case of a loop-span less than a pole pitch, it appears that, for such a loop, the only effective portion of the flux is included between the positions $\frac{\Theta}{2}$ and $\pi - \frac{\Theta}{2}$, where Θ is again the angular difference between loop-span and pole pitch. A discussion similar to the above leads to a breadth coefficient $k_c =$

$$\sum_{S=1-n}^{S=n-1} \cos S \frac{\phi}{2} \div n$$

which takes account of the fact that here there will be some loops of more, and others of less than a pole-pitch, and provides also for the case of an odd number of loops per coil, where the middle loop would obviously span exactly a pole-pitch.

Tables of coefficients worked out from the above formulae are appended. It is interesting to observe that the coefficients have the same numerical value for the same number of slots per phase per pole, whether the winding be a lap, or wave, or whether it be "coil-wound," which was, of course, to be expected, inasmuch as the conductors are all in series, and the different windings are merely tantamount to different methods of end-connecting.

It will be noticed, however, that a lap or wave winding in

which one of the winding pitches is fractional, would have a breadth coefficient as well as a distribution coefficient.

$$K_d = \sum_{S=1-n}^{S=n-1} \cos S.\frac{\phi}{2} \div n$$

TABLE I.—DISTRIBUTION COEFFICIENTS.

No. slots per pole per phase.	1	2	3	4	5	6	7	8	9	10
θ	180°	90°	60°	45°	36°	30°	25°7′	22°30′	20°	18°
Kd.	1.000	0.707	0.667	0.653	0.647	0.644	0.642	0.6405	0.640	0.639

$$K_b = \frac{\sum_{S=1}^{S=2n-1} \cos S.\frac{\phi}{2}}{n} \qquad K_c = \frac{\sum_{S=1-n}^{S=n-1} \cos S.\frac{\phi}{2}}{n}$$

TABLE II.—BREADTH COEFFICIENTS.

SINGLE PHASE.			TWO PHASE				THREE PHASE			
No. slots per pole.	θ	Kb	Slots per pole.	Slots per pole per ph.	θ	Kb	Slots per pole.	Slots per pole per ph.	θ	Kb
1	—	—	2	1	90°	1.000	3	1	60°	1.000
2	90°	0.707	4	2	45°	0.924	6	2	30°	0.966
3	60°	0.866	6	3	30°	0.911	9	3	20°	0.960
4	45°	0.924	8	4	22.°5	0.906	12	4	15°	0.9575
5	36°	0.951	10	5	18°	0.904	15	5	12°	0.9562
6	30°	0.966	12	6	15°	0.903	18	6	10°	0.9560
7	25.°7	0.975	14	7	12.°86	0.902				
8	22.°5	0.981								
9	20°	0.984								
10	18°	0.988								
12	15°	0.991								
16	11.°25	0.995								
20	9°	0.997								

It is to be carefully noted in the use of the summation signs occurring in the formulas, that from the very manner of their derivation, the coefficient of $\frac{\theta}{2}$ consecutive to $(n-1)$ is not $(n-2)$, but $(n-3)$; the next $(n-5)$, etc.

Electric Driving in English Spinning Mills.

BY T. SINGTON.

Electric driving in England has not made the progress it has in the United States; the number of installations is extremely limited both in spinning and weaving mills, and there appears to be no immediate prospect of its displacing steam to any great extent. It may be of interest to readers to place on record the actual opinions held by English experts in favor and against a system which has been largely adopted both in America and many European countries.

The electric driving of cotton-spinning mills is strongly opposed by those in favor of the existing system. They maintain that no larger production per spindle can be obtained by the introduction of electricity, which could not also be obtained without it. They insist that it is difficult to see how the regularity of speed of a rim shaft driven at from 800 to 900 revolutions through leather belting from a well-arranged line shaft, rope-driven from a suitable type of steam engine, can be improved upon. To which those in favor of electric driving reply that an increase in speed is not altogether necessary to yield a greater production; without any increase of speed it is possible by electric driving to get an increase of production due to greater steadiness. This simply means that the steadier driving would cause less breakage in the yarn and less stoppage from other causes; therefore, mules could be kept more constantly in motion and could produce more yarn. Bigger rims are being tried in many spinning mills to-day to increase speed; the practice is not always successful, due to the quality of the cotton used and to irregular driving, but the increased speed could be continued, it is maintained, under a system of electric driving; it follows that the production could be greatly improved in quantity. Electric driving may be introduced in two distinct classes of circumstances, namely, into entirely new factories, and into existing mills. In the former in general a modern plant on modern mechanical lines would be at least as economical, it is asserted, as the electrical; but in existing factories or mills circumstances need to be carefully considered and no general statement can be made as to which system will be best. In electrical transmission of power more than elsewhere circumstances alter conditions and results. Electric driving is after all only a method of transmitting energy and needs in addition to the prime mover, a generator and a motor, the two being connected by a wire cable. These, then, take the place of the driving and driven pulleys connected by a rope or belt, the usual ordinary method of transmitting energy, and in this sense the driven pulley is as much a motor as the electric motor. Just as in an ordinary rope or belt drive a certain amount of energy is lost in friction, so in an electric drive losses occur. Taking the efficiency of the electric generator, motor and transmission cable each at 95 per cent, the combined efficiency is about 85 per cent. To this, which represents a loss of 15 per cent, must be added that due to rope, belt or other mechanical connection between the motor and the line shaft or the machine as well as that between the prime mover (steam or other engine) and the electric generator, unless the latter is mounted on the flywheel shaft (direct coupled).

The friction losses of these latter-mentioned gears being roughly proportioned to the power transmitted, it will be evident that as much will be lost as in the usual rope, belt or gear drive and when to this is added the above-mentioned 15 per cent electrical losses, it is further evident that the saving in power will be a minus quantity to the extent of 15 per cent. It is asserted as a point in favor of electric driving that heavy shafts are replaced by small ones, but this will not effect such a saving as at first sight appears, when it is recognized that the friction of a quick-running shaft, the proper size for the power it has to transmit, is the same as that of a slow-running and larger shaft of the proper size for the same power. Moreover as light shafting is not generally sufficiently stiff even when large enough in diameter for the power to be transmitted, it is often necessary to increase the diameter, thus making an equal length more wasteful in friction than the usual slow-running shaft.

It is not denied that a substantial saving could be effected by substituting electrical transmission for an ancient, unduly heavy, out of repair wheel, belt or gear transmission; but in most cases an equal or greater saving would be effected by properly modernizing the drive on ordinary lines. In general there is little or no prospect of reaping any benefit in the direction of a reduction in power by the adoption of the electrical drive. The power in the factory is derived from the engine, the generator being only for electricity for the purpose of feeding distant electric motors; it is therefore difficult to see how the electric drive can be steadier than the elastic rope transmission drive would be from the same engine; the increased output claimed for the electric drive depends on this increased steadiness. There is no doubt that a change of speed in any part of the factory can be most readily effected by a judiciously split up electrical drive and any desired part can by its means be easily and gradually accelerated to the utmost speed limit; but as a rule in cotton factories where the speed of

the several parts of the plant depends on the feeding ability of each other, there is no advantage in speeding up a part and all can be easily speeded up at the engine as gradually as with the electrical drive.

In the cotton-spinning district of England (Lancashire) the possibility of economically driving cotton mills by means of electricity seems to many authorities entirely out of the question, except under one condition, viz., the concentration of the power plant of a number of mills. This idea is by no means new; years ago schemes were proposed involving the erection of central power stations in close proximity to the coal mines and the distribution of the electric energy by means of a high-pressure system of cables and wires to mills erected round about in the vicinity, along frontages of railways and canals. It is one of the most important and attractive points about electric driving that the motive power need not necessarily be generated at the spot where other considerations render it desirable to have the mill built. But for every mill to have its own generating plant for steam and electricity cannot possibly be economical and would be on a par with fitting every locomotive of an electric railway with its own steam and electricity-generating plant.

In some countries Nature has practically provided the sites for such central power stations, in the shape of rivers with a plentiful water supply, and as a consequence we find in South Germany, Switzerland, Savoy and Northern Italy many fine installations of this description sending out the power to mills many miles distant. Indeed the geological nature of the sites of the power installations in many cases absolutely precludes the building of mills in close proximity.

Such centers of water power being practically absent in England, the next best thing would be the building of huge central power stations driven by steam plant in close proximity to large coal mines as already suggested.

It would certainly be both interesting and gratifying to see such a concentration of power carried out in Lancashire and in other pronouncedly industrial districts for commercial and economic reasons. The use of electric drives with regard to departmental driving is a partly imaginary advantage, as such driving is in practice impossible in a cotton mill because the whole of the machinery is put down and sub-divided in such a manner as to form a harmonious whole and the various operations carried out in succession are in most direct interdependence. If the scutchers or the carding engines cease working the self acting mules must in due course do so likewise, for want of material to feed them and so on right through the entire plant of the factory. Short or overtime must therefore in most cases affect the whole mill and not one department only. In other manufactures departmental driving may at times be indispensable and can easily be arranged for by disengaging gear at various points.

Departmental driving increases the risk of breakdowns, inasmuch as the possibility of a breakdown of the various motors has to be taken in addition to that possibly ocurring to the prime mover, while the shafting in either case is practically immune. Moreover, the various departmental motors must be in the aggregate of considerable higher power than one main steam engine would have to be for running the same machinery plant satisfactorily. This is particularly evident where self-acting mules are at work, as the power absorbed by these machines varies abruptly between distant extremes. The momentum of the great flywheel of a large steam engine in connection with a well-designed sensitive governing arrangement meets temporary overloads without any speed variation and if the overload is continued simply slows down. But the same variations involve for the departmental electric motor considerable risks, as sudden overloads involve the blowing of the safety fuses, and if these are not set correctly the motor may be ruined instantly. In either case a stoppage of the machinery plant is involved.

Of course break downs of departments may be guarded against to some extent by the duplication of the electric plant, but then there is the double initial outlay, the interest on the money expended, the up-keep and so on to be considered. Comparing electric driving with ordinary steam driving from another point of view, it must be remembered that whichever is adopted the prime mover has always to supply the power and to be kept going although only one department of the works or mill may be running. With a sensibly laid-out arrangement for the main-line shafts and with pulleys, bearings, etc., of the best modern construction, the whole driven by a first-class steam engine of ample power, it is simply impossible to see where the advantage would come in under present conditions of cotton-mill building, of driving mills individually with electricity generated on the premises.

Experience in England, so far as it is available, goes to prove that isolated plants cannot compete with large power stations, where reliability as well as economy in both capital and running charges is an essential condition of supply. A saving in capital expenditure of about £10,000 can be effected in a 1500-hp mill where electric motors are installed and are driven by power obtained from an outside source, as compared with the older system of the mill engine, combined with rope driving. This large saving is brought about chiefly owing to the elimination of the engine, boilers and chimneys; but there are other factors, such as the use of high-speed and consequently lighter shafting, the abolition of leather belting, etc., all of which contribute materially to the reduction in expenditure. A modern central power house must be equipped with steam turbines in order to keep down the capital charges and as is well known the turning moment of electric power produced through the agency of a turbine is the very best that can be devised, owing to the purely rotary motion and the continuous flow of steam in the prime mover. Where reciprocating engines, on the other hand, are used, every irregularity in the turning movement of the engine is transmitted to the mill shafting, whether the power is conveyed electrically or through ropes. The result of the smooth drive and the elimination of belts is an undoubted increase in the output amounting to about five per cent, the comparison being between modern mills.

A highly important advantage which an outside supply of power has over either a rope drive or an isolated electrical drive, is that at a central power house a stand-by machine is always kept in reserve in case of accident to the running sets and as a result the stoppages at the mill are reduced to a minimum. A turbo-electric mill with isolated plant and no stand-by must always be a very risky undertaking. In ring spinning mills there is a great reduction in the up-keep of ropes and belts, where coupling has been adopted, which is practically negligible. Where doubling frames are used the ease with which a limited speed variation can be obtained is very great. A number of electric motors have already been attached direct to doubling frames, which are furnished with means of obtaining, by the turning of a handle, a speed variation of 10 per cent, which is usually all that is required. Such an arrangement is much more convenient and economical than the usual rather cumbersome system of changing gear. It is estimated that a textile mill with more than 300 horse-power installed can put down its own electrical plant, including buildings, boilers, engine, generators, motors, etc., can pay the whole of the running and establishment charges, can put aside 10 per cent for interest and depreciation on its capital expenditure and can rely upon getting its energy for about 0.4d. per unit.

The ordinary price for building and equipping a central power house in England ranges from £35 to £65 per kilowatt. The first cost of electricity and steam generated on the premises in a cotton-spinning mill should be about the same, including boilers, superheaters, condensers, turbo-alternators and three-phase motors, and buildings. The most modern practice in the electrical equipment of textile mills is to put down duplicate turbo alternators; each capable or running half the plant under normal conditions at the maximum efficiency and with the lowest steam consumption. Each is capable of giving an overload of 100 per cent for 10 hours, with an increase of about 12 per cent in the steam consumption.

The power required to drive a modern spinning mill, includ-

ing the engine, main rope drive, shafting and belts, but not the cotton machinery, is about 20 per cent of the indicated horse-power required to drive the mill when fully at work. In a weaving shed it amounts to about 25 per cent, but may be less. The loss in the main rope drive between the engine shaft and the mill shafting averages five per cent. In the electric drive there is a loss of five per cent in the generator, there is some loss, two to five per cent, between the generators and the motors in the cables and the gear, and the loss in the motors for cotton-mill work will average 10 per cent.

A cotton-spinning mill may be electrically driven by one of three methods: first, by using one large motor, replacing the steam engine and driving like the latter the various departmental line shafts by means of ropes laid in the rope race; second, by separate motors for each of the departmental shafts; the third method extends the idea of the second to each individual machine, dispensing with main-line shafts, pulleys and bearings. Several practical drawbacks make themselves felt when the second method is adopted and to a greater degree with the third; they arise from the fact that motor makers have not yet put motors on the market which with any speed and output combine economy. As a rule the smaller the output the higher the speed for economical running. The slow-going motor of small power is very dear and uneconomical and so is its prototype of the opposite extreme conditions. In most Englinsh cotton-spinning mills the number of main-line shafts is about eight or nine; of these the ring room, the mule rooms and the blowing room shafts usually go at a great speed, perhaps up to 350 revolutions per minute and the power absorbed is also rather great, so that we approach more nearly to the normal conditions for working a motor economically by connecting it direct to these line shafts. However, in the case of the blowing room, the power is rather against this simple application, since it is as a rule much less than in the two other rooms referred to. For the preparation room containing carding engines, drawing frames and the flyer frames, the speed of the line shaft is not so high and the power absorbed is less; thus both these conditions work against putting the motors direct on the line shaft and resort has to be taken to large pulleys with belt or rope driving. If we take the speed of these shafts too high we have difficulty with proportioning the belt pulleys driving the machines. Moreover, it must not be forgotten that other conditions remaining equal increase of speed of the line shafts means expenditure of additional power.

It will be found on looking through the lists of motor makers that they recommend high speed for the line shafts. The reason why they do so is evident from what has just been stated. It is evident from what has been stated that even with the full adoption of the second method gearing cannot altogether be dispensed with. Turning now to the third method under which a separate motor is used for each machine, it will only be necessary to refer to the preparation room. If we take an installation of 120 carding engines, by no means an exceptionally large plant, we find that each consumes on the average three-quarters indicated horse-power and makes 170 revolutions per minute, with driving pulleys 16 to 18 ins. diameter. Should 120 small motors be put down, each costing say £18, without the necessary wiring, etc., the total expenditure for the cards alone would amount to £2,160, with the cost of up-keep, repairs, etc., in addition. These small motors work at something like 1300 revolutions per minute and the speed relationship to the machines to be driven is about 7⅞ to 1. Assuming a pulley 6 ins. diameter as practical for efficient driving by belt, a pulley would be required for each machine about 46 ins. diameter, a monstrosity and expense, which cotton-machinery makers would condemn, as it is much larger than the normal size. There are other difficulties in such individual driving which are also very serious, such as the difficulty of keeping these motors clean, free from dust and above all, cool.

The spinning rooms have to be kept at a comparatively high temperature and moist, whereas the motors, to run at their best, ought to be in as cool surroundings as possible. In the case of ring spinning frames, separate motors to each machine are feasible enough, or for driving the counters of openers and scutchers, but they will not do for the separate driving of self-acting mules on account of their violently irregular absorption of power between far distant extremes. The best way to drive a mule room is after all a powerful and ample motor driving the common line shaft from which all the counters of the self-acting mules are driven. In English cotton-spinning mills, which have been filled throughout with electric driving, the group system has been adopted; the speeds of the shafts are extremely high, involving expenditure of power of the prime mover and sectional motors.

As ropes and pulleys form an essential feature of both steam and electrical driving, the following details should be noted: The transmitting power of driving ropes does not depend so much upon tensile strength as upon flexibility and consequent grip of both grooves and pulleys. It will be readily understood that by constantly reducing the periphery round which a rope passes, a point is reached when it absolutely refuses to yield further and its grip completely fails. Ropes differ in pliability, therefore the factor of safety should be such as will meet the demands of a fair average rope. Thirty diameters has undoubtedly proved a safe minimum. For example, if a rope 1¼ ins. diameter will transmit 10 horse-power at 2000 ft. per minute, running upon a pulley 30 times its own diameter or say 38 ins., the power of the same rope at the same speed, but running on a 30-in. pulley should not be reckoned at more than say 8 horse-power. It may always be best to adopt 1-in. ropes for a 30-in. pulley. The durability of a rope is in proportion to its sectional area. Therefore the comparative lives of 1¼ in. and 1 in. ropes stand in the relation of 25 to 16, minus abrasions due to contraction below the accepted minimum. The construction of grooves is very important; it may be definitely stated that experience has thus far decided in favor of angular as against curve-sided grooves, as it encourages that even compact and compression which adds so materially to the driving value and longevity of ropes. An angle of 40 deg. has been found best to answer the requirements for the ordinary sizes of ropes, say above 1 in., and as smaller ropes demand a more acute angle, 30 deg. for all below that diameter. Nothing is gained by imposing flanges upon the mid-feathers; the same angle should be carried from root to terminals, the latter being simply rounded off. The depth of the groove should be such as to prevent the rope from reaching the bottom when compressed to the utmost.

Well-made 1¼-in. ropes representing the standard are found capable of comfortably transmitting 10 horse-power, which means 50 horse-power for 5000 feet per minute. All other sizes are calculated upon the basis of the comparative sectional area. Thus a 2-in. diameter rope equals 13 horse-power; a 1½-in. rope, 7.4 horse-power; a 1¼-in. rope, 5 horse-power; a 1-in. rope, 3.3 horse-power, and intermediate sizes in the same ratio.

The initial cost of electrical driving in cotton-spinning mills in England may be summarized as follows, say in a 1500-hp mill: The ordinary horizontal cross-compound engine costs £5,000 to £5,500, including rope-pulley and condensing plant. Two 750-hp turbo-alternator sets would cost about £8,500. The electric drive also requires cables, switch gear and motors. The cost of the first-mentioned may be assumed to be balanced by the cost of the second motive pulleys of the engine drive. The cost of the motors may be put at about £4 per horse-power or £6,000 in all.

British Central Station.

Last year's report of the Burton-on-Trent municipal electricity works is published in the London *Electrician*. During the year the restricted-hour system has been adopted for motor users. The total number of kw-hours generated during the year was 1,164,355, that is, 20 per cent more than last year. The maximum load was 866 kilowatts. The total expenditure, including operating costs and capital charges, was 4.252 cents per kw-hour generated, while the corresponding receipts were 4.572 cents per kw-hour.

Practical Application of Wireless Telephony.

As noted on page 799 of our issue for Oct. 26, the United States navy has arranged to install De Forest wireless telephone equipments on its Pacific vessels on account of the satisfactory results obtained with equipments on the battleships *Virginia* and *Louisiana* of the Atlantic fleet. It is believed that an outline of the transmitting and receiving apparatus will prove of interest to our readers.

In the transmitting circuit there are produced "sustained" oscillations having a frequency of about 40,000 per second;

FIG. 1.—AUDION DETECTOR.

that is, the sustained frequency is considerably above the audible range. The oscillations are transferred from the circuit in which they are produced to the antenna circuit by means of an air-core transformer. A microphone transmitter inserted in the latter circuit serves for varying the circuit resistance, and thereby varying the strength of the transmitted oscillations in consonance with the words spoken into the mouthpiece of the microphone. For the production of the "sustained" oscillations,

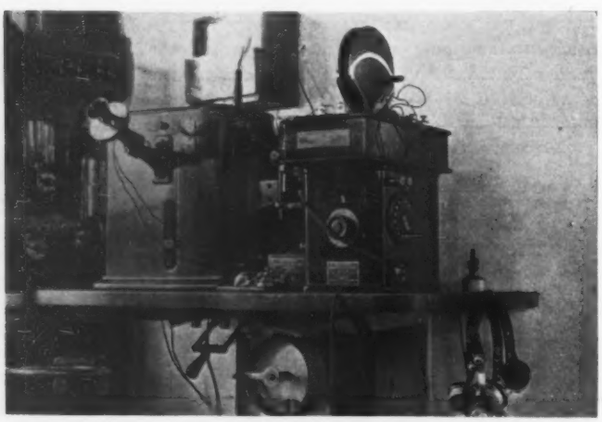


FIG. 2.—WIRELESS TELEPHONE TRANSMITTER AND RECEIVER.

use is made of the flame of an alcohol lamp placed in shunt across the terminals of a 220-volt direct-current generator and in series in a circuit containing an induction coil and a condenser; the frequency depends upon the inductance of the coil and the capacity of the condenser.

The receiving circuit is "tuned" to correspond in frequency to the "sustained" oscillations of the transmitting circuit. Associated with the receiving circuit is an "audion" and a telephone receiver. The fluctuations in the strength of the received oscillations affect the conductivity of the heated gas within the "audion," and the variations in the strength of the current from a battery in the telephone circuit are manifested as sounds in the receiver.

A view of the audion, a detailed description of which was given in our issue of Nov. 3, 1906, is shown in Fig. 1. A complete equipment of transmitting and receiving wireless tele-

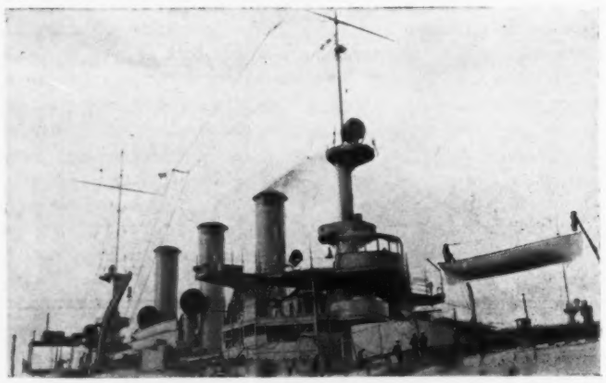


FIG. 3.—TELEPHONE ANTENNA.

phone apparatus is shown in Fig. 2, while the telephone antenna in place on the U. S. flagship *Connecticut* is indicated in Fig. 3. Similar apparatus will be installed on 27 other United States war vessels. Although the contract requires telephonic transmission for only 5 miles, it is stated that communications have been heard at a distance of 22 miles.

New Telephone Patents.

For a long time there has been an occasional demand for a loud-speaking telephone, and this demand has been met by a very powerful receiver equipped with a megaphone. Such a receiver can be adjusted to speak with the usual volume of the human voice. Articulation is not good, however, except with careful adjustment, because of the abnormal excitation of the diaphragm. J. A. Baker, of Seguin, Tex., has proceeded upon another principle in developing a loud speaker. He has arranged a considerable number of instruments in a single rectangular casing and has arranged their circuits in such electrical relation that they act simultaneously.

J. A. Gordon, of Shawnee, Oklahoma, has invented a transferable transmitter antiseptic device. This is a cup of metal adapted to mount upon the transmitter mouthpiece. The lip of the mouthpiece slips within the cup and is secured by two clamping levers which are operated by springs and two buttons projecting at diametrical points through the walls of this cup. The usual antiseptic is placed in an aperture which registers with the transmitter opening.

A step-by-step lockout selective party line ringing device forms the subject of a patent granted to J. H. Blythe, of Denver, Col. This embraces the usual electromagnetic pall and ratchet devices to step ahead and restore a commutator device at each station.

Some time ago Mr. F. E. Mayberry of Medford, Mass., obtained a patent for a step-by-step party line selective system, the successful use of which with common battery systems requires a special arrangement of cord circuits at the switchboard. This selective system provides controlling switches at the stations which are advanced by current in one direction and restored by a reversal of this. The present invention relates to the central-office end of this system. The supervisory relays are polarized; the armature remains at rest in any position. The hook switch at the station when operated puts a momentary ground on one predetermined side of the line and in descending upon the other. These grounds cause the supervisory relay armatures to oscillate to one side or the other to light or extinguish the supervisory lamp as the case may be.

LETTERS TO THE EDITORS.

Distortion in Telephonic Transmission.

To the Editors of Electrical World:

SIRS:—Referring to the article by Mr. Louis Cohen in your issue of Sept. 21, entitled "Distortion in Telephonic Transmission," I wish to point out that Mr. Cohen is mistaken when he says that all previous investigators assumed that the constants of the line are the same for all frequencies. He will find by a closer inspection of Heaviside's writings that such is not the case. He will find that the attenuation constant

$$\beta = \sqrt{\tfrac{1}{2}\omega C\left\{\sqrt{\omega^2 L^2 + R^2} - \omega L\right\}}$$

is true, even if R is not the true ohmic resistance as determined by Wheatstone bridge, but the effective resistance taking into account the skin effect.

The distortion on a New York-Chicago line due to a cause of this kind is small in comparison with the distortion produced by the terminal apparatus, and nobody pays any attention to it. The chief trouble on overhead lines is not distortion, but loss of volume. In the case of telephonic transmission over cables it is different; here the distortion is a very serious factor, but it is not influenced appreciably by the skin effect, because the size of wire employed is small.

There are patents covering the employment of stranded wire for telephonic transmission, so as to avoid the skin effect. Nobody pays any attention to them, because the troubles arising from the skin effect are of no practical consequence.

Columbia University, M. I. PUPIN.
NEW YORK.

Long-Distance Wireless Telegraphy.

To the Editors of Electrical World:

SIRS:—It has been reported that the Port Morien wireless station of the Marconi Company, in Cape Breton, recently picked up a message transmitted from the wireless station at Manila, P. I., announcing the arrival of the American cruiser, *Philadelphia.* Whether or not the accuracy of this report has been officially confirmed I am unable to state, but the circumstance has suggested to me a line of thought which I should be pleased to have published and discussed in your columns.

In such a wireless transmission the wave front is progressively attenuated during its propagation in all directions, until it has reached the circumference of the great circle 90 deg., or approximately 6000 miles distant from the sending station, and the minimum intensity of the wave should exist at points located on or near this circle. Beyond this circle the intensity of the wave should progressively increase until that meridian is reached which is 180 deg. from the sending station; and, furthermore, the intensity should continue to increase along that meridian until a position corresponding to that of the antipodes of the sending station is reached, at which point the intensity should again be at a maximum.

This would seem to be true by reason of the fact that after passing the great circle 90 deg. removed from the sending station, the wave front would progressively contract and thereby regain intensity until, by concentration at the point located diametrically opposite to the sending station, the intensity would be theoretically equal to that at the sending station. The actual intensity would, of course, be much less than that at the sending station, owing to the dissipation of energy in transmission.

It is a peculiar circumstance that the difference in longitude between Port Morien station and the Manila station is approximately 180 deg., which former station, from the above considerations, would be especially favorably situated for receiving waves transmitted from the Manila station, although it would appear that the intensity should be greater and, therefore, the transmission better at a point much farther south on the meridian passing through Port Morien, *i. e.*, at approximately Long. 60° W. and Lat. 15° S., corresponding approximately to the position of Manila's antipodes.

In conclusion, it would seem that the most difficult transmission in any direction should be over the first 90 deg., and that there should be a progressive improvement thereafter up to the meridian 180 deg. from that of the sending station, with a further uniform improvement along that meridian to the position thereon diametrically opposite to the sending station.

CHICAGO, ILL. ERNEST F. SMITH.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Alloy Steels.—E. A. WATSON.—Special alloy steels have recently been introduced (as repeatedly noticed in the Digest) for transformer construction on account of their comparatively small hysteresis and eddy-current losses. Little use is made of these steels, however, in dynamo electrical machinery, possibly on account of their expense or on account of their lower permeability. It can be shown, however, that the saving due to the adoption of the alloy steel "when reduced to capital far outbalances the extra cost of the machine." The lower permeability is of greater importance since the output for a given copper loss is determined by the flux density which can be allowed in the teeth of the armature, and it is hence desirable that the permeability of the material should be as high as possible. The author has tested four samples of special alloy steels with an apparatus of Kapp intended for measurements of high flux densities. The four alloys are No. 1, called Stalloy, and No. 4, Lohys, of British make, while samples 2 and 3 were of German origin. The analysis of sample 2 is 0.03 per cent C, 3.40 Si, 0.01 P, 0.32 Mn and 96.20 Fe. The results of the tests are given in Fig. 1. The curves show the relation between flux density and ampere turns. The permeability of sample 4 is highest, although it is probably not as high as that of ordinary armature sheets. The alloy steels differ considerably among themselves, the one specimen of German manufacture (No. 3) having a considerably higher permeability than the other (No. 2) and having the knee of the curve considerably higher up. In no case, even with a magnetization of upward of 1000 ampere turns per cm, did the flux density for the alloy steels reach the

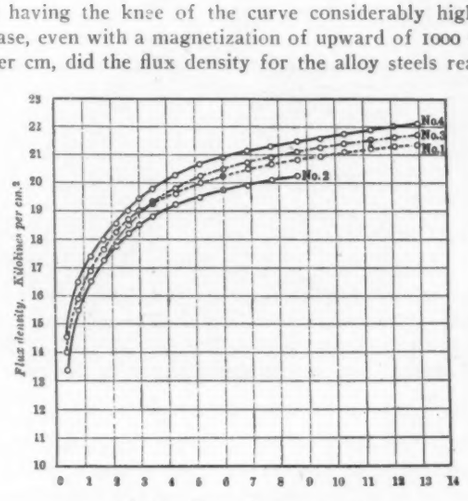


FIG. 1.—RESULTS OF TESTS.

true value of 22,000 lines per sq cm. Flux densities obtained in these measurements are the true flux densities in the steel, there being no paper or any other insulation interposed between the strips. The apparent density in the teeth is con-

siderably higher than the true value, and the author deduces the excitation required for a given apparent density with different ratios of slot to tooth. He shows that although it is not possible to exceed more than 24,000 or 24,500 lines apparent density with the special alloy steels, yet it is possible to go about as high as it is usual in modern practice. In order to obtain this density with alloy steels somewhat more excitation is required than with ordinary steel, but in direct-current machines, at any rate where the air gap is greater than that necessary for mechanical clearness, this might to a large extent be avoided by decreasing the air gap, the increased reluctance of the teeth at such high densities being practically equivalent to an air gap. Indeed from the point of view of good regulation it is better to have highly saturated teeth than a long air gap as the reluctance of air is a constant quantity. Considering the great decrease of the constant losses with alloy steels, the extended use of these in electrical machinery of all descriptions deserves the attention of designers.—Lond. *Elec.* Oct. 18.

Lamps and Lighting.

Efficiency of Lamps.—H. Lux.—Continuations and conclusion of his long serial giving an account of his very extended experimental researches as to the efficiency of various sources of light. The final results are given in the following table.

Source of Light.	Power consumption in watts.	Total spherical radiation in watts.	Spherical light radiation in watts (between 0.4 and 0.8 μ wave length.)	Ratio of light radiation to total radiation in per cent.	Ratio of light radiation to power consumption in per cent.	Mean horizontal cp in Hefner candles.	Mean spherical cp in Hefner candles.	Watts consumed per mean spherical Hefner candle.	Electrical power equivalent of one mean spherical Hefner candle.
Hefner candle	86.3	9.96	0.089	0.89	0.103	1.	0.825	104.6	0.108
Kerosene lamp	508.0	102.2	1.26	1.23	0.25	14.2	12.0	42.3	0.105
Acetylene flame	96.0	9.78	0.62	6.36	0.65	7.7	6.04	15.9	0.103
Incandescent gas lamp. Ordinary (without cylinder)	716.7	147.	3.28	2.26	0.46	107.	89.6.	7.98	0.037
Ordinary (with cylinder)		112.1		2.92					
Inverted (without glass)	571.0	143.	2.9	2.03	0.51	107.	82.3	6.97	0.035
Inverted (with glass)		97.6		2.97					
Carbon filament lamp (with glass)	98.23	63.5	2.03	3.2	2.07	31.5	24.5	4.09	0.085
Carbon filament lamp (without glass)		75.2		2.7					
Nernst lamp (without series resistance)	165.	122.2	6.96	5.7	4.21	120.1	94.9	1.74	0.073
Nernst lamp (with series resistance)	181.4				3.85			1.91	
Tantalum lamp	44.0	25.2	2.15	8.5	4.87	34.6	26.7	1.65	0.080
Osram lamp	38.3	22.5	2.05	9.1	5.36	36.3	27.4	1.43	0.075
Direct-current arc lamp	435.0	301.8	24.3	8.1	5.6	190.	524.	0.83	0.047
Enclosed direct-current arc lamp	541.0	286.	6.2	2.2	1.15	200.	295.	1.31	0.021
Flame arc, yellow light	349.7	295.	52.4	17.7	15.00	907.	1145.	0.31	0.046
Flame arc, white light	348.0	304.5	26.3	8.6	7.56	602.	760.	0.46	0.135
Alternating-current arc lamp	180.6	91.2	3.4	3.7	1.84	109.	89.	2.06	0.039
"Uviol" Mercury-Vapor Lamp	198.6	91.3	5.3	5.8	2.24	437.	3.44	0.58	0.015

A comparison of different sources of light must, of course, be based on the spherical radiation. The efficiency might be defined in two different ways. One definition which is purely physical would be to define the efficiency as the ratio of the radiation within the visible part of the spectrum (arbitrarily defined as being between 0.4 and 0.8 μ wave length) to the total radiation. The figures for this efficiency are given in the fourth column of the table. In the second definition of efficiency the physiological effect on the eye is taken into account and "efficiency" is determined from the ratio of hefner candles produced to watts consumed. The reciprocal values of this "efficiency" are given in the eighth column of the above table. While the figures of "efficiency" for these two definitions are, of course, different, yet if a series of the different sources of light is arranged according to their efficiency, about the same series is obtained for the two definitions. The fifth column gives the ratio of light radiation to power consumption in per cent, and it is very interesting to note that in this respect all electric lamps are far superior to flames and gas lamps, etc. The last column gives the so-called electrical equivalent of one mean spherical hefner candle, that is, the ratio of the watts of spherical radiation within the visible spectrum to the mean spherical hefner candle. From the concluding remarks of the author the following may be noted: While a carbon incandescent lamp of 16 horizontal candle-power consumes about 3.5 watts per candle-power, a continual increase of the voltage raises the candle-power to about 2000 just before the filament is destroyed. The specific consumption is simultaneously reduced to about 0.13 watt per candle-power. That means that in the moment of most intensive incandescence with the present means one is able to transform more than 56 per cent of the consumed power into light by means of purely thermal radiation. The goal should be to find a material which is able to be used under such conditions for a length of time. The author believes that the metallic filament will not solve this problem, because the fusion point represents a limit. Only a carbon filament would be able to withstand such a temperature for any length of time, and it would have to be absolutely homogeneous, since only then would it be able to resist the danger of cracking, which is primarily the result of the liberation of occluded gases. In order to develop lamps of higher efficiency it seems more promising at present to make use of light production by luminescence instead of by means of pure thermal radiation. This is shown by the development of the flame-arc lamps and the mercury-vapor lamp. The last column in the above table shows that the electrical equivalent of light is not a constant for all different sources of light. This is, of course, clear because in the above definition of the electrical power equivalent of light the spectral composition of the light has not been considered. However, the above figures justify one interesting conclusion. The sources of light in which finely divided carbon is brought to incandescence, and also the electric incandescent lamps, have an electrical power equivalent of light ap-

proximately equal to 0.1 watt per candle-power. These are the sources of light which operate on the principle of pure thermal radiation. In the electric arc lamps the values average about 0.04 watt per candle-power, while the value for the mercury-vapor lamp is as low as 0.015. These are those sources of light in which luminescence phenomena are made use of. In the latter, therefore, there is required only one-half the power necessary for pure thermal radiators, and the reason for this is easily understood if the mechanics of lighting is reduced to the electronic theory. From this point of view it is interesting to note that the figures for the Welsbach gas lamp are near those for the electric arc lamps. It may be concluded therefrom that the specific composition of the Welsbach mantle permits the use of pure thermal radiation for the production of electronic oscillations in a manner that is possible otherwise only by electrical means. The strongly selective radiation of the Welsbach mantle is not sufficient to explain the very low value for the electrical power equivalent of light for this mantle.—*Zeit. f. Beleucht,* Aug. 10, 20, 30, Sept. 10, 20, 30.

Train Lighting.—An illustrated description of the following method of the British Thomson-Houston Company. The principle is shown in Fig. 2, where 1 is the armature of the

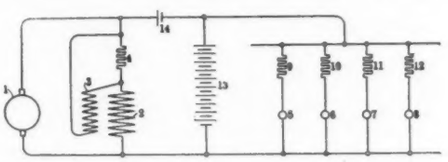


FIG. 2.—DIAGRAM OF CONNECTIONS FOR TRAIN LIGHTING.

generator to be regulated. The main field winding is at 2, while an auxiliary differential winding is at 3. This winding is arranged to be supplied with voltage varying at a greater rate than the variation in speed in driving. For this purpose it is connected across a resistor, 4, having a high positive temperature coefficient of resistance, such as the iron wire used as ballast in the Nernst lamp. The lamps to be supplied with energy are shown at 5, 6, 7, 8; they are in series with the iron-wire resistors 9, 10, 11, 12 which consume any excess voltage. The storage battery, 13, supplies energy to the load when the voltage of the generator becomes too low, while it receives energy from the generator at other times. The aluminum cell, 14, acts as an electrolytic interrupter which prevents the storage battery from discharging backward through the generator at times when the voltage of the generator is below normal. Whenever the generator tends to increase the voltage due to an excessive speed, there is in the first place an increase in the resistance of the iron wire, 4. This not only tends to keep down the current in the winding, 2, but the division of the current between the resistors 4 and 3 is altered so that the winding, 3, now carries an increased proportion of the total current. Thus the effect of any small increase of voltage on the generator is met by a multiplied demagnetizing effect on the generator field by reason of the presence of the iron resistor, 4. The maximum variation of voltage is thus rendered small. Any variation which still remains is taken care of by the iron resistors 9, 10, 11, 12.—Lond. *Elec. Eng'ing,* Oct. 10.

Arc Lamp.—An illustrated description of a new lamp of British make, called the "Newarc" lamp. It is suitable for burning as an enclosed lamp (single globe) on both alternating and continuous circuits, under the normal conditions which commonly obtain with arc lamps—that is, it operates equally well in parallel or series. The lamp depends for its working on the well-known expanding and contracting properties of steel and iron wire when heated by the presence of an electrical current and cooled when the current ceases. In the "Newarc" lamp a steel band is utilized to perform the hot-wire function of the lamp, the width being about ⅛ in. and the gauge about 0.004 in. In Fig. 3, *F* is the steel heating strip, the ends of which are fixed at the point *W*, being one of the terminals, and at the point *V*, this latter being the short end of a lever, *G*, pivoted to the bracket *O*. To the long end of this lever the spring *R* is attached, this spring being adjustable from the wing-nut *N*, which is screwed into the hook holding the lower end of the spring. The porcelain roller *X* acts as a pulley for the heating strip *F*, and also affords a means of adjustment for the length of the arc by the turning of the wing-nut *A* to which the pulley bearing is attached. Movement of this nut alters the tension of the heating strip. There is also attached to the

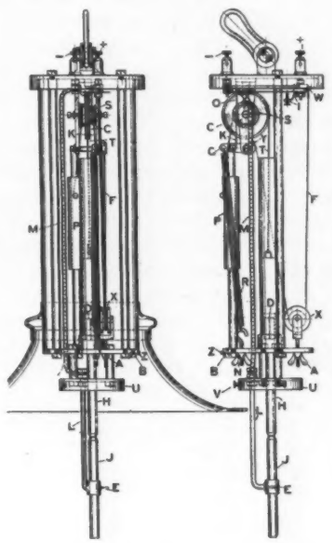


FIG. 3.—MECHANISM OF ARC LAMP.

lever *G*, in addition to the controlling spring and heating strip, a short length of brass or steel chain, *K*, which passes several times round the brake drum *S*, and is finally attached to a flat spring in the hood of the lamp. A larger pulley wheel, *O*, is fitted to the same spindle, and over this pulley the flexible metallic cord *T* for the carbon holder *D* and the balanced weight *P* passes. The weight *D* is heavier than that at *P*. The action of the lamp is very simple. With the circuit open, the pull of the strip F is sufficient to counterbalance the pull of the spring *R* to keep the brake chain free of the brake drum. When the circuit is closed the strip *F* expands, and the spring *R*, getting the ascendency, draws down the chain *K* and strikes the arc by slightly revolving the drum to which the cord *T* is attached. The current variations due to the lengthening of the arc while burning tend to alter the balance of the strip and spring, and by this means the lamp feeds. It does not, however, go out before feeding, the automatic adjustment being sufficiently sensitive to ensure a constant feed during the time of burning. A cut-out is fitted in the hood of the lamp to safeguard the strip and prevent its being fused by the passage of an excess current. The contacts of this cut-out, which is a simple thermostat, are shown at 1. The heating strip *F*, upon which, of course, the action of the lamp depends, is made of watch-spring steel heavily nickel-plated to resist the effects of dampness and moisture, particularly in salt-laden atmospheres on the sea-coast.—Lond. *Elec.,* Oct. 18.

Metallic-Filament Lamps.—Notes of two recent British patents. According to one granted to the Consortium für Elektrochemische Ind. Ges., metallic filaments of tungsten for incandescent lamps are bent to shape while heated in an inert or reducing atmosphere. It is stated that tungsten is not ductile or malleable except at very high temperatures. According to a patent granted to Lake (Parker-Clark Electric Company), filaments for incandescent lamps are made by heating a carbon filament in an atmosphere containing marsh gas, olefiant gas, carbon dioxide and in presence of a substance containing silicon; by the resulting reaction a deposit of pure silicon is obtained on the filament.—Lond. *Elec. Eng'ing,* Oct. 10.

Metallic Flame-Arc Lamp.—C. E. STEPHENS.—An illustrated article describing the principles of the metallic flame-arc lamp and its advantages for street lighting from the operating point of view.—*Electrical Journal,* October.

Projector Arc Lamps.—An illustrated description of a recent improvement of arc lamps for projectors patented by Siemens Brothers & Company. The chief feature is a clock-work mechanism for feeding the negative electrode. The positive electrode is moved and controlled by electromagnetic devices in the usual manner.—Lond. *Elec. Eng'ing,* Oct. 17.

Power.

Munich.—The hydroelectric station at Moosberg, on the Iser, which feeds Munich, is, with the single exception of the station at Kykelsruth, in Norway, the only one in Europe with three-phase transmission at 50,000 volts. This station, which was recently opened, transmits energy a distance of about 30 miles, 6 per cent being lost in the line. Two feeders erected on poles, and each consisting of three copper wires 16 sq. mm in section transmit the required 4200 kilowatts. The usual lightning protectors are provided. At present the station is working at only three-quarters of its output, as the power consumption is least in the summer. In spring and autumn the station will be fully loaded, while in winter it will require help from the existing steam station. Next year, when the hydroelectric station to the south of the town will also be opened, Munich will possess two cheap sources of energy, and great savings in coal and oil will be effected.—Lond. *Elec.,* Oct. 11.

Large Gas Engines.—A fully illustrated account of a recent trip made by English engineers to Continental Europe. The primary object was to inspect examples of large gas-engine installations at work. Among the engines inspected were three 1650-hp engines running on blast-furnace gas at a French steel works, and driving alternators in parallel, a 1300-hp engine running on coke-oven gas at a German Government mine, where three more of the same size are in course of erection and a further 3000-hp engine is to be put down, and a pair of 2200-hp engines driving continuous-current generators, and working on blast-furnace gas, at a large iron and steel works in addition to some smaller sets and gas-driven blowing machines. The works of Ehrhardt & Sehmer at Saarbrücken, and of the Felten-Guilleaume-Lahmeyer-Werke Company at Frankfurt, were visited, and the opportunity was taken to visit the electrical main shaft winding-plant at the Matthias Stinnes mine.—Lond. *Elec. Eng'ing,* Oct. 17.

Electricity in Copper Works.—H. R. Speyer.—An illustrated description of the electric equipment of the Mansfield copper mines in Germany. The gas-driven electric station generates three-phase alternating currents at 3000 volts. The distribution is by underground cables partly at 3000 volts and partly at 10,000 volts. Curves of cost show a considerable advantage for electric working as compared with the steam winding carried out under identical conditions in some of the same company's other mines.—Lond. *Elec. Eng'ing,* Oct. 10, 17.

Low-Pressure Steam.—J. R. Bibbins.—An article giving notes on the possible development of low-pressure steam-turbine work. It is shown that the turbine can utilize low-pressure steam to so much greater advantage than is possible with steam engines that it becomes desirable to run a piston engine at high pressure, and use a low-pressure turbine between the engine and the condenser. Thus the turbine acts as the third cylinder in a triple-expansion system, but at a much higher efficiency than is possible with piston engines.—*Electric Journal,* October.

Electric Crane Works.—An illustrated description of a British crane factory which has arranged during the past few years for the manufacture of the electrical equipment of cranes supplied by them.—Lond. *Elec. Eng'ing,* Oct. 10.

Pumps.—An illustrated article on centrifugal turbine pumps for high lifts.—Lond. *Elec. Review,* Oct. 4.

Traction.

Electric Traction in England.—In the annual railway returns of the British Board of Trade for 1906, some statistics are given of the electric railways in the United Kingdom. Excluding the electric lines of the Lancashire & Yorkshire and North-Eastern Companies (for which separate details are not given), the number of passengers carried was 267,826,481, or nearly 25 per cent of the total number of passengers carried on all the railways in the Kingdom. The total quantity of electrical energy used for all purposes (including the L. & Y. and N. E. Railways) was 159,581,401 units, compared with 100,977,467 units in 1905.—Lond. *Elec. Eng'ing,* Oct. 17.

Railway Signals.—J. B. Struble.—In a continuation of the long serial on railway signaling, the double-rail return system is discussed, in which both rails are used as return conductors for the train propulsion current simultaneously with the alternating block-signaling current. The use of this method on direct-current traction systems is first described, and then its application to alternating-current traction is briefly discussed.—*Electric Journal,* October.

Installations, Systems and Appliances.

Berlin.—K. Wilkens.—Continuations of his very long and fully illustrated description of the Berlin electricity works at the beginning of 1907. In the present installment the electric equipment is dealt with, the dynamos, transformers, converters, switchboard and the safety devices being described in detail.—*Elek. Zeit.,* Oct. 10.

Automatic Method of Starting Motors.—M. Kallmann.—A translation in abstract, with illustrations, of his German paper recently noticed in the Digest on an automatic method of starting motors by using iron resistors like the ballast in the Nernst lamp.—Lond. *Elec.,* Oct. 11.

Three to Two-Phase Transformation.—E. C. Stone.—An article in which the author employs the notation of C. H. Porter for the determination of the current in the several windings of two transformers connected in the ordinary method for transforming from three phase to two phase.—*Electric Journal,* October.

Wires, Wiring and Conduits.

Porcelain.—D. Harvey.—An article on the designing and testing of porcelain for electrical purposes. The use of a glaze on porcelain insulators is usually desirable, as it provides a smooth, glossy surface which does not accumulate dust and moisture as readily as does the rougher unglazed surface. The brown glaze has become practically the standard color. The dry process of porcelain manufacture is suitable only for such pieces of porcelain as can be formed by metal dies and which are to be used on comparatively low voltages. The clay, which is rather dry when pressed in the die, does not have the compact body obtained by the wet process and necessary for high-potential porcelain. Porcelain should be as nearly uniform in thickness as possible, as this facilitates uniform drying of the material. Pieces having considerable variation in thickness are very likely to become cracked or warped during the process of drying and firing. While porcelain of the best quality has a very high dielectric strength, yet with increasing thickness it becomes much more difficult to obtain well-vitrified ware without small cracks or other flaws in the interior. This fact practically limits the voltage which a single piece of porcelain can withstand, and it is therefore customary to use multiple-part insulators for the higher voltages. In general, insulators should be so designed that no single piece will be tested at more than 80,000 volts, and a somewhat lower test is desirable. There is a common impression that breakdown over a high-tension insulation is due to surface leakage. But there is no appreciable leakage unless the surfaces are wet or covered with some conducting material. The principal cause of the breakdown seems to be the rupture of the film of air immediately adjacent to the insulator, on account of excessive electrostatic strain. Glass insulators have been used to quite an extent on circuits of less than 25,000 volts. They have the advantage of low cost and cheap inspection. Porcelain is somewhat more expensive than glass but has greater mechanical strength and is less brittle. The metal pin is considered preferable to the wooden pin for use with insulators which have ample margin of safety for the service conditions. When this margin of safety cannot be obtained by the insulator alone a wooden pin is advisable in order to obtain the necessary insulation. However,

with long spans, especially with high voltages, metal pins are necessary in order to obtain the required mechanical strength. The conditions under which porcelain insulators are tested should correspond as nearly as possible to the conditions of service. A very convenient method of testing porcelain-lined insulators is to place them inverted in water, with the head immersed in water so as to cover the side wire groove, this water forming one terminal, while the hole for the pin is filled with water in order to serve as the other terminal.—*Electric Journal*, October.

Enamel Wire.—R. APT.—A paper read before the Berlin Electrical Society. The author remarks that enamel wire was introduced first in the United States, thin wires (up to about 0.2 mm diameter) being insulated by so-called cellulose-tetra acetate, while for thicker wires a special enamel was employed. The Allgem. Elek. Ges. is now using a cheap enamel for all kinds of wire down to a diameter of 0.05 mm and up to 1.8 mm. Various data and diagrams are given concerning the better utilization of space which thereby becomes possible in comparison with other kinds of insulation. The flexibility is so good that the wires may be wound in a coil 3 to 4 times their own diameter. In general the flexibility is greater at higher than at lower temperatures. The insulation resistance of the wires against mercury is about 10 megohms per km. The perforation e. m. f. against mercury is from 500 to 700 volts for wires up to 100 mm, while for thicker wires it increases up to 2500 volts. If the wires are placed in water the perforation voltage is smaller because the water enters into the very fine pores of the surface. In general, a perforation e. m. f. of 200 volts may be obtained for wires up to 0.1 mm and 300 to 400 volts for thicker wires. The insulation is not uniform enough to guarantee the perforation voltage within a few per cent. The maximum temperature at which the coils can be used is 150 deg. C., but a lower temperature should be employed if the windings are subjected to a mechanical stress.—*Elek. Zeit.*, Oct. 10.

Diameter of a Cable.—H. LUCKIN.—A note giving a formula for finding the diameter of a cable composed of a number of small wires. This formula is $D = d\sqrt{n}\,c$ where D = diameter of cable over bare copper, d = diameter of one wire, n = number of wires, c = constant to allow for clearances between wires owing to wires being round; its value is 1.33.—Lond. *Elec.*, Oct. 11.

Electrophysics and Magnetism.

Electric Radiations.—W. H. BRAGG.—We know now a number of different types of radiation each of which is able to ionize a gas, to act on a photographic plate and to excite phosphorescence in certain materials. The present paper contains an attempt to find whether there is anything to be learned from a comparison of the properties of the various rays. It appears to the author to be a first deduction from such a comparison that in all cases the bulk of ionization which the rays effect is of the same character, and consists in the displacement of slow-moving electrons or delta rays, from the atoms of the gas or other substances which they traverse. In other words, the ionization which is measured in the ionization chamber is due almost wholly to the emission of slow-speed electrons from the atoms of the gas contained in the chamber or of the chamber walls, and this is true for all forms of radiation. Moreover, there is some evidence to show that the speed of the delta rays is almost independent of the cause and manner of their production. If attention is turned to all secondary radiation other than the delta rays, it seems to be in general a rough reflection or scattering of the primary. The author then discusses the law of absorption of different types of radiation in passing through matter. He then attempts to estimate the properties of some rays which might exist, though the fact has not been proved as yet. He considers the possibility of the emission of neutral particles such as a pair consisting of one alpha or positive particle and one beta or negative particle. On this view it would be possible for a portion of a disintegrating atom to break away, to pass over an appreciable distance, and finally to become part of another atom, the atomic weight of which would thereby increase. Internal atomic energy might be transferred at the same time. In the second part of the paper the author discusses the possibility that the gamma and Roentgen rays may be of a material nature. Since the properties of gamma rays are among the properties of Roentgen rays, an hypothesis which will suit one form of radiation will also suit the other. However, much more is known about Roentgen rays than about gamma rays. It is of interest, therefore, to consider the extent to which the additional knowledge can be fitted to a neutral pair hypothesis. It is true, of course, that the æther pulse theory has been most ably developed, and is now widely accepted. Nevertheless, the evidence for it is all indirect; and indeed some of it is overrated. It is quite possible that æther may not, after all, constitute the bulk of Roentgen radiation. The author concludes that a stream of Roentgen rays contains some æther pulses, but it is not easy to explain all of the properties of Roentgen rays on the æther pulse theory. The explanations are easier if the rays are supposed to consist mainly of neutral pairs; and the existence of such pairs is not improbable *à priori*. —*Phil. Mag.*, October.

Units, Measurements and Instruments.

Photometry.—A full account of the third meeting of the International Photometric Commission held in Zurich in July, concerning which previous notices have already appeared in the Digest. The following is the official resolution which was unanimously adopted. The International Photometric Commission, after having heard and discussed the reports of the work carried out in the German, English and French laboratories, on the proposition of the sub-committee composed of Messrs. Vautier (president), Brodhun, Laporte and Paterson, accepts the following values for the ratios of the luminous intensity of the flame standards now in use:

Carcel	10.7$_6$	Hefner
Vernon Harcourt	10.9$_8$	"
" "	1.02$_0$	Carcel

The above ratios have been chosen in order to avoid numbers which are less than unity. These values are correct within the limits of plus or minus 1 per cent. The values apply to the luminous intensity of the lamps when burning respectively under their normal atmospheric conditions; that is to say—

Barometric pressure, 760 mm.
Humidity:

Carcel	10.0	litres of water vapor per cubic meter of dry air
Hefner	8.8	" " " " " " "
Vernon Harcourt	10.0	" " " " " " "

The ratios given below are deduced with sufficient accuracy from the data already given:

	Carcel	Hefner	Vernon Harcourt
Carcel	1.0	10.7$_6$	0.98$_0$
Hefner	0.93$_0$	1.0	0.091$_5$
Vernon Harcourt	1.02$_0$	10.9$_8$	1.0

—Lond. *Electrician*, Oct. 18.

Production of Alternating Currents of Any Frequency.—R. RUEDENBERG.—Continuous low-frequency alternating currents are produced by dynamos, while for the production of high-frequency oscillations electric oscillating circuits, containing capacity and inductance, are made use of. The latter method, however, produces in general waves which are gradually damped. The author shows that it is possible to combine the two methods in such a way that the oscillating circuit serves simply for producing the right frequency while the dynamo supplies the energy consumed. The e. m. f. of a series-wound dynamo is proportional to the current for a low magnetic density in the iron. If such a dynamo is connected to a circuit containing resistance, inductance and capacity in series, then Ohm's law gives directly a differential equation which when integrated shows that an alternating current can be produced in the circuit and that three different cases are possible. If the e. m. f. of the dynamo is Ki where i is the current, then K is constant and depends only on the construction and the speed of the dynamo; it is the e. m. f. of the dynamo per unit of current. If R is the resistance of the total internal and external circuit, then the three different cases mentioned above are, first,

that K is smaller than R; second, K equals R, and third, K is greater than R. In the first case, if K is smaller than R, the energy supplied by the dynamo is not sufficient to supply the whole energy consumed in the circuit so that the oscillations will gradually diminish. If now the speed of the dynamo is increased, its e. m. f. and the coefficient K also increase and finally the condition in which K equals R is reached. The oscillations of the circuit are then maintained undamped since the energy consumed in Joulean heat radiation, etc., is supplied solely from the dynamo. The frequency of the oscillations depends simply on the self-inductance and the capacity of the oscillating circuit. If the speed is further increased, the oscillating circuit would receive more energy from the dynamo than it can give off. This condition, of course, cannot exist for any length of time. The second case, in which K equals R, is the important one. The author has made experiments with a small direct-current series motor, the armature and poles of which were made of laminated iron. The machine was connected to small paper condensers and no special inductance was required, the self inductance of the machine itself being sufficient. He obtained in this way alternating currents the frequency of which could be changed from 20 to 70 periods per second when the capacity was changed from 20 to 2 microfarads. A method of this kind is thought to be specially suitable for producing high-frequency currents for wireless telegraphy. An arrangement which may be used to advantage is

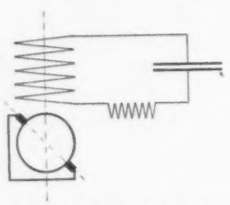


FIG. 4.—DIAGRAM OF ARRANGEMENT.

shown in Fig. 4, where the machine is not in series with the oscillating circuit but is connected to the latter by electromagnetic induction. The armature brushes are displaced from the neutral zone and are short-circuited while the ends of the field windings are directly connected to the condenser. Besides a smaller voltage at the commutator, a smaller self-induction of the whole machine is hereby obtained so that it is possible to obtain higher frequencies. This arrangement may be considered as a modified "repulsion" motor, the wattless magnetizing current being supplied from an external source—the condenser.—*Phys. Zeit.*, Oct. 15.

Resistor Coils.—C. V. Drysdale.—Continuations of his long paper on resistor coils and comparisons. In the present instalments the author discusses the desirable features and the temperature compensation of resistor coils. The temperature compensation of a resistor coil may be made either by connecting it in series or in shunt with another coil. A special case of shunt connection is the disposition of another suitable metal on the coil itself whereby at the same time a protective effect is obtained. Experiments of the author have shown that with nickel-plated resistor wire a very good compensation can be obtained. He then passes over to the discussion of a comparison of resistor coils. The paper is to be concluded.—Lond. *Elec.*, Oct. 11, 18.

Watt-hour Meters.—H. Miller.—An illustrated article on the construction of watt-hour meters. After some remarks on alternating-current watt-hour meters of the induction type the author gives general notes on bearings, the torque, weight and friction of watt-hour meters, the counter frictional torque, regulation, recording mechanism, energy losses, accuracy, meters of large rating, the checking by means of standard instruments and operating conditions.—*Electric Journal*, October.

Telegraphy, Telephony and Signals.

Electric Oscillators.—J. A. Fleming.—The conclusion of his article giving an elementary theory of electric oscillators. The practical applications of the theory are as follows: If a vertical Marconi antenna be set up for wireless telegraphy, and it be gradually inclined over or placed in a slanting position, then for equal distances round it, the radiation is enfeebled by such inclination, but is also made unsymmetrical, remaining strongest in the direction opposite to that towards which the antenna leans. Many observers have experimentally noted this fact, and some of them have stated the direction of maximum radiation of the inclined antenna wrongly. A point of some importance to notice is that electric wave antenna, being radiators, fulfil the laws of all other radiators, and in particular the law of exchanges, in that they not only absorb the radiation of that wave length which they emit, but they absorb best on that side towards which they radiate best. Hence a bent or inclined antenna is not only an unsymmetrical radiator; it is also an unsymmetrical absorber. If, then, a bent antenna, having a small part of its length vertical and a much longer part horizontal, is employed as a receiving antenna, it will receive best from the direction opposite to that towards which the free end points. If, then, the horizontal part points north, it will receive best waves coming from the south, and if the horizontal part can be swivelled round, such a receiving antenna can be employed to locate within certain narrow limits the direction of the sending station. Mr. Marconi employs also combined bent sending and receiving antennæ placed back to back, the one radiating best in the direction opposite to that in which the free end points, and the other absorbing best in a similar direction. These results were discovered by a laborious process of experiment and practical trial, but they are capable of being fully explained on the theory given that such a bent radiator is equivalent to the combination of a magnetic or closed oscillator with an electric or open oscillator. The limitation which has to be imposed on the discussion to render the mathematical analysis not intractable is that the current in the oscillator has the same value at all parts of its length at the same instant, and that the free charges are confined to the extreme ends. Neither of these assumptions is strictly true of the real wire antennæ used in radio-telegraphy, but it is approximated in the case of a wire antenna with a capacity or metal plate at the top. Experiment, however, shows that the observed results obtained with bent or inclined antennæ in radio-telegraphy are in general accordance with the predictions of the elementary theory given, but the problem of discussing mathematically the case of inclined or bent antennæ with distributed capacity and inductance, and, therefore, with currents varying from point to point in it, is one of extreme difficulty.—Lond. *Elec.*, Oct. 11.

Training of Telegraph Engineers.—O'Meara.—An address delivered by the author who is engineer in chief of the British General Post Office, before the Post Office Institution of Electrical Engineers. He laid stress upon the value of the personal equation in the make-up of an engineer, and in particular the power of an individual to solve the personal equations of his subordinates. Commercial aptitude ranks second, in his opinion, and he emphasized the importance of a training in commercial subjects, such as accounting, patent law, the law of contract, etc. Finally, the value of a study of sociology was touched upon, together with the necessity for constantly maintaining the attitude of a student towards all progress.—Lond. *Elec. Eng'ing*, Oct. 17.

Miscellaneous.

Manufacturers and Students.—An article in which the author points out that there are very few manufacturers who recognize the fact that a student of to-day is the potential buyer of to-morrow. It pays the manufacturer to try to reach him. This may best be done through his professor or lecturer, by supplying the latter, if desired, with some form of a cabinet in which samples of the products of the manufacturer are laid loose. Each of the samples should bear the maker's name and description which becomes impressed on the student's mind so that in after years when in a position to place orders he remembers that such and such a firm makes such and such goods and that is the firm which gets the business.—Lond. *Elec.*, Oct. 11.

Electricity in South Africa.—Various notes stating that the electric power station and sewage disposal works at Muizen-

berg have been opened, that street lighting by osram lamps is to be introduced at Woodstock at a cheaper rate than quoted by the gas company, and that electric train lighting is making considerable progress in South Africa.—Lond. *Elec. Eng'ing*, Oct. 10.

Sales Contracts.—D. A. BRENNAN.—The conclusion of his serial. In the present instalment the author discusses damages in general, liquidated damages and penalties, assignments and statutes of limitation.—*Electric Journal*, October.

Electrical Laboratory.—S. P. SMITH.—A fully illustrated description of the equipment of the Elektrotechnic laboratories of the Institute of Technology of Karlsruhe, Germany.—Lond. *Elec.*, Oct. 11.

BOOK REVIEWS.

THE ELEMENTS OF ELECTRICAL ENGINEERING. A text book for technical schools and colleges. Vol. II, Alternating Currents. By Prof. W. S. Franklin and Prof. William Esty. New York: The MacMillan Co. 378 pp., 290 ills. Price $3.50.

The present book is the companion volume to the above authors' book on direct-current machinery, a review of which appeared in our issue for July 14, 1906. The authors throughout the second volume have well maintained the high standard reached by the first volume. There are 15 chapters dealing with the general theory of the alternator and the representation of alternating voltage and current, the characteristics of synchronous motors and converters, stationary transformers, induction motors, single-phase series motors, and transmission lines. Appendix A is devoted to a discussion of the phenomena in circuits containing inductance and condensance, while Appendix B gives a large number of practical engineering problems that will prove of great value to the student.

The explanatory matter throughout the book is based on the geometric representation of the alternating quantities and the trigonometric and algebraic determination of their numerical values. One chapter of the book, however, is devoted to an outline of the complex-quantity method of determining numerical relations; attention is called to the fact that this method is merely a systematic scheme for carrying out the combined trigonometric and algebraic method. Although a large percentage of the writers on alternating-current subjects fail to distinguish between such familiar quantities as "power" and "energy," the present authors have kept their text singularly free from such sources of confusion to the uninformed reader, and have consistently considered "power" in its true significance as "flow of energy." The treatment of "electric resonance" is exceptionally good in all respects except one: In section 36, on "Multiplication of Current by Resonance," the diagrams are so arranged, and the statements are so worded, that the uninitiated reader would be justified in assuming that if in a certain circuit containing an inductive impedance coil there be connected in parallel with the coil a condenser of certain capacity the current in the coil will be greatly increased. The exact conditions under which the increase can take place should have been stated definitely and not left to the untrained imagination of the reader. The above criticism does not apply to the descriptive matter itself, but to the interpretation to which it may lead.

The discussion of the voltage and the voltage regulation of alternators, to which the 24 pages of Chapter VII are devoted, is probably the best simple and effective treatment of this subject to be found in text-book literature. That portion of the treatment of synchronous motors which deals with the normal operation and the hunting of these machines is excellent for its simplicity in presentation, but certain of the results derived from calculation of the excitation characteristics seem to need checking. The most systematic treatment in the book is that dealing with the general alternating-current transformer, including the in-induction motor, to which 106 pages are devoted. Much emphasis is placed on the advantage of using the "equivalent circuits" of the transformer and the induction motor, and the diagrammatic representation of the current and e. m. f. relations on the basis of the equivalent circuits. The chapter on the single-phase series motor discusses briefly the characteristics of the series and the repulsion motor, and suggests several novel methods for preventing sparking.

The book will serve excellently for the purpose for which it was intended, namely, a text-book for engineering students in technical schools and colleges.

EXERCISES ET PROJETS D'ELECTROTECHNIQUE. Par Eric Gerard et Omer de Bast. Tome I. Applications de la Théorie de l'Electricité et du Magnétisme. Paris: Gauthier-Villars. 239 pages, 96 illustrations. Price, 6 francs.

This is the first of two volumes of problems prepared by the authors for students in their course at L'Institut Montefiore, Liège, Belgium, in order to fix more firmly in their minds the principles of which the problems are applications. The present volume relates to the theory of electricity and magnetism, and a second volume will be devoted to practical applications of theory to apparatus and electrical installations. The plan pursued is excellent in that it involves more than the mere working out of problems by a mechanical operation of little benefit to the student. In each case the numerical operations are preceded by a deduction from the fundamental principles, of the necessary formulas, so that the student cannot escape connecting the theory with its practical application. The problems are well chosen, having for the most part a practical bearing.

The subjects covered in the six chapters of the book are magnetism, electrostatics, laws of the electrical current, electromagnetism, electromagnetic induction and alternating currents. In the latter case, many of the solutions are based on both a graphical method and on the use of complex quantities. If the authors had not been constrained to follow the methods of text-books used by their students, they might have simplified to an extraordinary degree most, and perhaps all, of the solutions of alternating-current problems, by separating the various steps in the analysis or synthesis and using simple triangles in computing numerical results—a method by which the most complex problems in alternating currents may be solved with a mathematical knowledge extending little beyond arithmetic. The book will be found of much value to all teachers of electricity, and furnishes an admirable means for a review of electrical theory to men whose knowledge has become rusty and who would not care to return to the ordinary text-book for a course in repolishing.

SPECIFICATIONS FOR STREET ROADWAY PAVEMENTS. By S. Whinery, Mem. A. S. C. E. New York: Engineering News Publishing Company. 56 pages. Price, 50 cents.

The preface states the object of the specifications included in this book is to set out definitely and clearly as practicable the requirements for construction of good pavements of the several standard kinds. For the case when circumstances require the engineer to provide for the construction of new kinds of pavement not covered by the specific forms given, a general form is also provided.

Telephones at a Rifle Range.

BY F. A. CORNELL.

The successful use of telephones in the Japanese army during the late war with Russia has thoroughly aroused the American war department to the advantages of such means of communication, and this enthusiasm has imbued the National Guard of several states with a similar determination to develop the best facilities in this line. This policy includes the use of telephones in rifle-range equipment, as well as in the complicated signalling mechanism of sham maneuvers.

Camp Perry, Ohio, has been so well equipped with modern appliances that the National Shoot was held there during the late summer and early fall. Part of this equipment included over two score complete telephone circuits for use in reporting each shot from "pit" to "firing line." These were operated by the Signal Corps of the Ohio National Guard, and while they

are really an adjunct to the regular reporting routine, their value in case of delays and misunderstandings was very evident, and rendered them indispensable. On the long ranges, from 1000 yards up, the opportunities for their use are, of course, vastly increased, and in such instances they enable the range officers to dispense with the services of a large detail of mounted orderlies.

On the firing line the instruments are mounted on suitable desks about 8 yards in the rear of the competitors and about 5 yards from the rear of the scoring tables. The standard

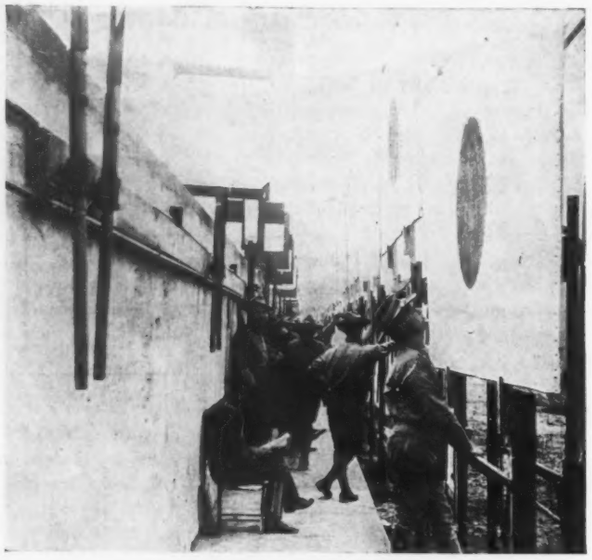


FIG. 1.—WORK IN THE LONG-RANGE PIT, CAMP PERRY.

government field sets, manufactured by the Dean Electric Company, of Elyria, Ohio, are used, and the wiring is laid through underground ducts. Each instrument in "the pit" is in charge of an operator, and there is a complete circuit from target to firing line for each fifth range.

When a team takes its position on the range, the officer in

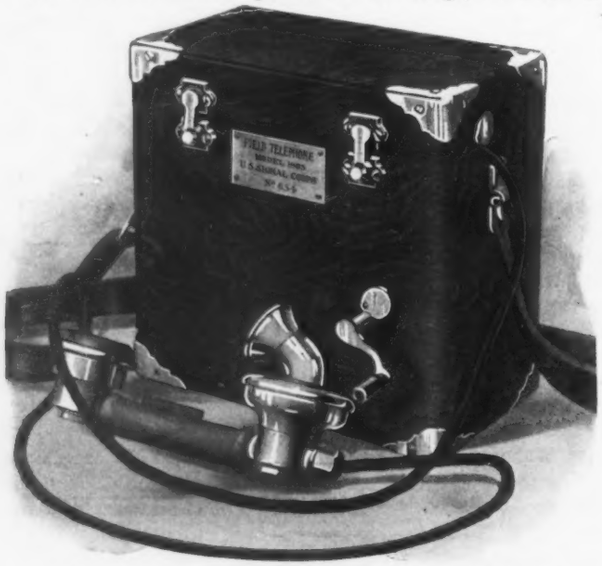


FIG. 2.—SET OF PORTABLE TELEPHONE INSTRUMENTS.

charge is continually advised of the exact state of affairs in "the pit" (where the targets are handled) by the use of these field sets. Red markers are raised in front of the targets when they are not in use, and at the command from the officer in charge of the range, transmitted over the telephone to the officer in charge of the pit, these markers are removed and the first volley fired. The targets are arranged on rollers, two per set, and so constructed that when one is in position the other drops down into the pit below the protecting bank of earth on the side facing the firing line. After each shot the position of the "hit" is indicated to the scorers, who are located two yards to the rear of the firing squads, by placing a metal disc marker on the hole in the target. These discs are of various colors—white for bull's-eye, white cross on black ground for four points, and black for three, while the red range flag is waved in front of the target in case of a miss. Should the scorer fail to get the report of any shot the signal corps telephone operator at the firing line rings the pit and calls for the "last shot on range No. 65," or whatever the case may be. Detailed information over the line enables the scorer to keep his records up to

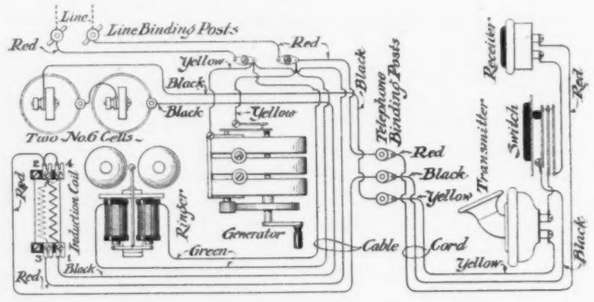


FIG. 3.—CIRCUIT DIAGRAM OF TELEPHONE SET.

scratch, and gives the competitor the advantage of the exact location of his shot, so that he may make proper sight adjustment or wind allowance.

The telephone instruments, shown in the accompanying illustration, are compact, and at the same time complete. The cabinet provides spaces for two No. 6 dry cells, a three-bar ringing generator, a ringer, an induction coil, and a hand microphone set. This microphone is of an improved pattern which combines convenience in using with strength and freedom from trouble. The body of the set is of aluminum, the receiver and transmitter shells are of nickel-plated brass, to properly protect those parts against the most inclement weather. To assist in installation and in the location of any troubles that may arise, each set is provided with a circuit diagram, which enables even a layman to connect and operate the apparatus.

Electrical Gold Mining in Mexico.

The Lluvia de Oro Gold Mining Company has purchased through L. L. Nunn, of Provo, Utah, the machinery for a complete power plant to be operated in connection with its mines in the Sierra Madre Mountains, near El Fuerte, Mexico. It is to consist of a 500-kw Allis-Chalmers steam turbine, running at 3600 r. p. m., direct-connected to one of the same company's alternating-current generators designed especially for operation with it at 60 cycles, three-phase and 600 volts. Excitation at 120 volts will be obtained from two small exciter sets, each of 15 kilowatts capacity, one driven by a high-speed engine and the other by an Allis-Chalmers induction motor. There has also been built by the Allis-Chalmers Company, to be installed with the turbo-generator unit, a Tomlinson barometric condenser, with 36-in. head, and an 8-in. x 16-in. x 20-in. dry vaccum pump. The water for the condensing system will be brought by gravity to a cold well near the condenser at a height to be forced into the condenser by atmospheric pressure.

The complete equipment, which was shipped soon after the placing of the order, will be installed in a substantial stone power house. The fact that the plant has been designed by Mr. Nunn, who is one of the best known constructing and consulting engineers in the country, insures its being a model one in every respect. As all of this apparatus will have to be carried along a difficult road over the mountains, after being taken by boat from Cuaymas to Topolobampo, and thence by rail a part of the distance, the transportation of it has been a problem.

Electric Furnace and Pyrometer Outfits.

A preliminary model of the new patented quartz-lined electric furnace, designed by Prof. Wm. H. Bristol, was described in the ELECTRICAL WORLD, January 5, 1907, page 9, and a few of the possible applications of it for practical work were mentioned. This furnace has now been developed into a suitable form for use with the Bristol recording electric pyrometer (described in the ELECTRICAL WORLD, Nov. 10, 1906, page 929), in such a way that the temperature inside the furnace may not only be controlled but also automatically recorded on a chart. A special laboratory unit consisting of the electric furnace and a recording pyrometer with attachments, designed for determining the recalescent points of steel and for hardening small tools, is shown in Fig. 2, with the various parts all mounted on the same standard in such compact form that the complete unit may even be conveniently used on an office desk, the electric energy being obtained from a lighting circuit.

The electric furnace itself is of very simple construction, its special feature being the lining of fused quartz which makes it possible to apply the full value of current suddenly and thus to heat up the furnace quickly without danger of cracking its interior. Even when the furnace is heated to a bright red, a cold piece of steel may be introduced without injury to the quartz lining which at the same time serves as a perfect insulation between the metal and the heating coils. A rheostat may be used to regulate the temperature, but for some applications it may be dispensed with, as, for instance, in the use of the furnace as a soldering copper heater with direct lamp plug connection. In that case, the winding of the heating coil is so arranged that the maximum temperature of the furnace will be correct for continuous service and not so high as to oxidize the soldering copper. For many other applications, as for tools and for laboratory work, both a rheostat and a pyrometer are used with the furnace to great advantage.

Fig. 2 shows the new laboratory unit especially designed for determining the recalescent points of various kinds of steel. The electric furnace is here shown in circuit with a rheostat so that after the full value of the current has been turned on, bringing the furnace up to a bright red heat on the inside

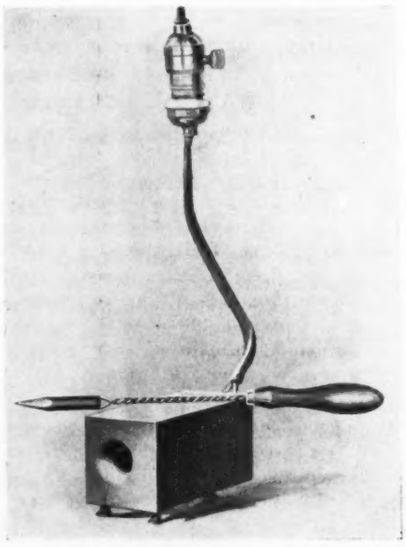


FIG. 1.—QUARTZ-LINED FURNACE FOR HARDENING SMALL TOOLS.

almost immediately, the rheostat may be adjusted so as to maintain the desired temperature.

This illustration also shows the complete recording pyrometer mounted on one standard and consisting of a platinum-platinum-rhodium thermo couple and a recorder. The couple of the pyrometer fits into the furnace and has its "cold junction" (or point where the flexible leads begin) inserted into a breaker of ice-water. The e. m. f. of this thermo couple varies directly with the temperature inside the furnace and actuates the recording instrument of the electric pyrometer, the recording arm of which makes a continuous record automatically on its circular chart. The recording pyrometer is equipped with a semi-transparent smoked chart and a special vibrating device which brings the sensitive surface of this chart in contact

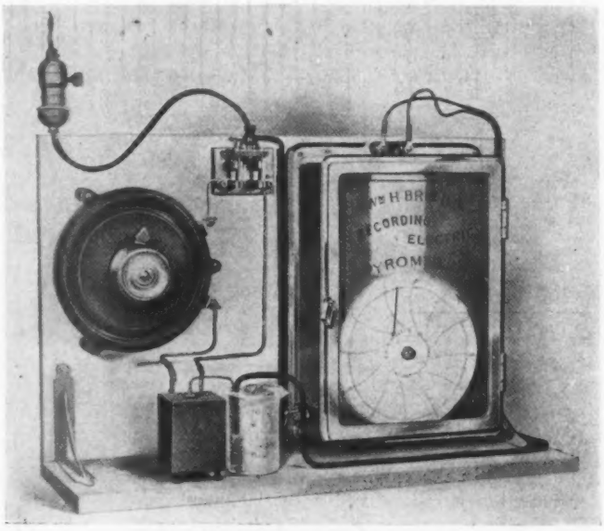


FIG. 2.—FURNACE AND PYROMETER OUTFIT FOR DETERMINING RECALESCENT POINTS OF STEEL.

every half second with the recording arm. As friction between the recording arm and the chart is eliminated, a perfectly accurate record is obtained directly without the use of relays or other complicated devices. In order that very quick variations of temperature may be recorded, the chart is arranged to revolve once in sixty minutes.

The special design of this laboratory unit makes it very convenient for measuring the recalescent points of steel, or in other words the temperature at which a molecular transformation occurs below which the steel cannot be hardened. After the electric furnace has been heated up by turning on the current, a small cylindrical sample of the steel is inserted into the top of the furnace and the tip of the thermo couple is introduced into the hole of the sample. As the steel is gradually heated up by the furnace, the rising temperature inside it will be recorded on the chart. After the temperature has been raised as far as desired, the piece of steel may be withdrawn from the furnace without disturbing the couple and as the steel cools, its fall in temperature will also be recorded on the chart. The records of these rising and falling temperatures will be shown as curves on the charts on which the recalescent points will be easily discovered.

The temperature which would be right to harden one kind of steel would not be the right one to produce good results with another kind of steel. By making series of tests like those described above, the manufacturer can find out what temperature is the best one for him to use in hardening each particular lot of steel. The old-fashioned idea that steel could be hardened by guess-work is fast giving away to the realization that a piece of steel may become either worthless or precious according to the heat treatment which it receives.

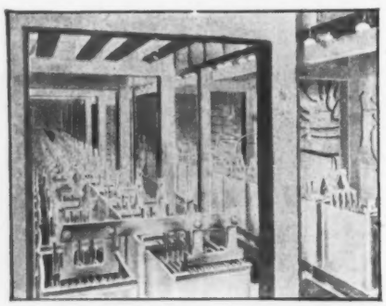
The special laboratory outfit described above is being manufactured by Wm. H. Bristol, at 45 Vesey Street, New York City.

Storage Batteries in Isolated Plants.

One of the recent examples of the value of a storage battery for continuous service in isolated plant work is that of the Hotel La Reine, Bradley Beach, N. J., which is equipped with the "Unit" Accumulator type of battery. The Hotel La Reine was first opened to the public early in July of this year, and is one of the finest of the Atlantic Coast seaside resorts. The house contains 120 rooms, all of which afford a view of the

sea, and the furnishings, etc., are in keeping with the general character of the place.

The electric service equipment is particularly notable, in that it has been designed to afford absolute reliability and continuous service. No expense has been spared to this end. The power plant contains two Northern direct-current 110-volt generators direct-connected to Secor kerosene engines. In the power house, but partitioned off from the engine room, is a battery of "Unit" Accumulators consisting of 122 cells in



STORAGE-BATTERY EQUIPMENT.

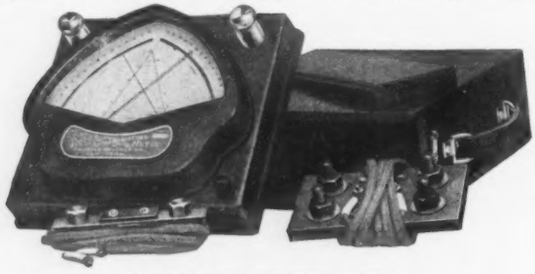
glass jars. In the engine room a suitable booster is provided for charging purposes, and a special panel containing battery meters, circuit-breakers, end-cell switches, etc., is installed with the main switch board.

The battery has a rating of 40 amperes at 220 volts for eight hours on one charge and is principally designed to operate the elevator service of the hotel. The plant is arranged, however, so that the battery may be used for break-down lighting service or for watchman's lighting when it is not desired to run the main dynamos. The importance of continuous service —particularly for hotels—is readily appreciated, which has brought the auxiliary use of storage batteries to supply this indispensable feature, ordinarily lacking in isolated plants, into prominence.

The electric service equipment, as well as the hotel itself, was designed by Mr. John E. Nitchie, of New York City, and the entire battery plant, which has been particularly satisfactory, was furnished and installed by the National Battery Company of Buffalo, N. Y.

Combination Current, Electromotive Force and Power Meter.

The combination meter shown herewith has been designed especially for the purpose of economizing bench space, and at the same time producing an accurate instrument that will replace three ordinary type of direct current meters. It gives simultaneous indications of volts, amperes, watts and horse-power on a single dial. There are in reality two individual direct-current



PORTABLE COMBINATION METER.

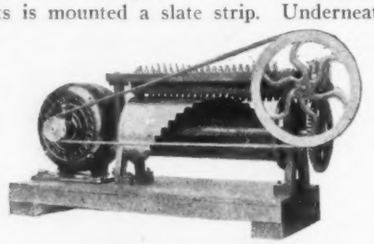
instruments, a voltmeter and an ammeter, each of which is made on the d'Arsonval galvanometer principle; that is, a rectangular coil of wire rotatable in a small annular gap between a cone and pole pieces. The voltmeter may be used with external resistors in order to increase the e. m. f. and power range. The ammeter is equipped with self-contained shunts up to and including a range of 200 amperes. For two or more ranges the instrument is provided with interchangeable shunts, either separate or contained in one compact box.

The Victor combination meter as outlined above is manufactured by the H. W. Johns-Manville Company, 100 William Street, New York, which also applies the combination scheme in a line of compact switchboard instruments.

A Flasher With Handwriting Effects.

A new device that has made its appearance called the "Model C Flasher," for use where lamps are to be lighted one after another until all are lighted. The application of this flasher is, for instance, in a script letter sign where a writing effect is desired. However, it may be used to produce streak of lightning effects, or in any other manner where a rapid movement of light is desired by the use of incandescent lamps. The drum of the flasher can be made to revolve very quickly without causing excessive wear in any of the moving parts.

The construction is simple, as well as substantial. On cast-iron uprights is mounted a slate strip. Underneath this, and



MOTOR-DRIVEN FLASHER.

secured to it, are phosphor bronze springs, one for each circuit, or individual flash. These springs carry the current. There is a binding post on top of the slate strip for each spring, and in addition one for the return wire. The drum, which is mounted on the main shaft, is used only in a mechanical way, as no current passes through it. This flasher is made for practically any number of circuits, ranging from 25 to 110. It is made by the Electric Motor & Equipment Company, of Newark, N. J.

Puddled Semi-Steel Valves.

The increasing use of high pressures and superheated steam has created a demand for something better than the ordinary cast iron, brass mounted valves, and to meet this demand, the Lunkenheimer Company offers its line of "Puddled" Semi-steel valves. The manufacturers state that "Puddled" Semi-steel is an extremely high grade iron and steel alloy, of very close grain and great strength, and not to be confounded with the mixtures made in cupolas where the admixture of steel with the iron is beyond control, and the resulting metals sadly lacking in uniformity. The method employed is to melt the iron and steel together in a specially modified "puddling" furnace, thoroughly mixing them during the process, and by pouring off at the proper time and temperature, an invariably uniform alloy is secured. The best grade of Lake Superior charcoal iron is used exclusively. In "Puddled" Semi-steel, the percentage of deleterious chemical elements is kept very low, a result which is absolutely impossible to obtain in any cupola. By this process, the tensile strength can be controlled at any point between 30,000 and 40,000 pounds per square inch. Ordinarily, the strength maintained is 35,000 pounds, which is over 100 per cent stronger than the cast iron used in the majority of valves. "Puddled" Semi-steel valves have been extensively used in high-pressure plants carrying superheated steam, and in other places where the physical demands on a valve are great, and in every case they have given complete satisfaction. The body, disc, gland and yoke are made of "Puddled" Semi-steel, the seat ring and disc lock-nut of nickel bronze, the gland, stuffing-box and yoke bushings of Navy composition, and the stem of steel. This is a combination which cannot be too highly commended.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Reports indicate that there was a contraction in business as a result of the financial crisis, but only to the extent compelled by inability to get money. The general uneasiness arising from the same cause has almost entirely calmed down, and more confidence is manifested. Coincidently with the enforced employment of credit instruments has been witnessed a marked increase of transactions on a purely cash basis, and large quantities of stocks, grain and other produce have changed hands at concessions in most cases. There was a sensible diminution of jobbing trade activities, some reduction of forces in railroad improvement work and in other industries and some retarding influence upon retail trade. Collections, naturally, showed some effect of the disturbance. The most noticeable feature of the readjustment of conditions has been the lowering of prices of commodities to a basis where lagging demand is expected to revive. Grain and cotton were quick to respond and live stock and meats are lower. The iron and steel industry reports new demand quiet as a whole, and copper felt the effect of the sharp decline in quotations in sales of many million pounds. Lumber, hardware, and in fact building materials of all kinds are in slow demand. Car shortage is widespread, affecting the movement of grain at Buffalo, of coal at all leading points east and west and of lumber in the Pacific Northwest. New business in structural material was of small proportions, and steel rails were a little more active in comparison with recent marked dullness. Copper was much firmer, lake brands having risen rapidly to 14¼c. after being quoted at a shade under 12c. Electrolytic ranged from 13¾c. to 14¼c. The recovery is attributed to heavy speculative buying, but domestic business was not of marked proportions. The improvement, however, may not be permanent until conditions in the brass goods, wire and electrical trades take a turn for the better. *Bradstreet's* reported 223 business failures last week, against 220 in the week previous and 163 in the corresponding week last year.

EXPORT OF MANUFACTURES.—Manufactures are forming a larger share of the exports of the United States than ever before, and a larger share of the imports than at any time since 1890. They formed practically 44 per cent of the exports during the nine months ending with September, 1907, while they had never but once reached 40 per cent in any fiscal year covered by the records of our export trade. Manufactures formed in the fiscal year 1880 14.78 per cent of the exports of domestic products; in 1890, 21.18 per cent; in 1900, 35.3 per cent; in the fiscal year 1907, 39.94 per cent, and in the nine months ending with September, 43.83 per cent of the total exports of domestic products. The total value of manufactures exported was, as shown by the official figures of the Bureau of Statistics of the Department of Commerce and Labor, in round terms, in 1880, 122 millions; in 1890, 179 millions; in 1900, 484 millions; in the fiscal year 1907, 740 millions; and in the nine months ending with September, 574 millions; the average per month being, in 1880, 10 millions; in 1890, 15 millions; in 1900, 40 millions; in 1907, 62 millions, and in the nine months ending with September, 63 millions. In 1880 the average value per day of manufactures exported was one-third of a million dollars; in 1890, a half million; in 1900, 1⅓ millions; in 1907, 2 millions, and in the nine months ending with September, 2 1/10 millions.

SNOW MOUNTAIN POWER.—It is stated from San Rafael, Cal., that the Snow Mountain Electric Power Company, a new concern backed by former United States Senator Felton, will enter the field soon as a competitor of the Pacific Gas and Electric Company in Mendocino, Sonoma and Marin Counties. The company has been in existence but a short time, but already has erected several sub-stations and strung a number of miles of high tension wire in Sonoma and Mendocino counties to carry the electrical energy from the central power plant at Snow Mountain, which is 150 miles from San Rafael. Manager McGrath has petitioned for a franchise to erect poles and supply current to consumers in San Rafael. He will apply for franchises in San Anselmo, Sausalito, Mill Valley and Belvedere. Should he be successful, the service will be inaugurated within a year. The company intends to run feeders throughout the counties in which the Pacific company has lines.

HAWAIIAN LUMBER.—The largest contract ever made in the Hawaiian territory has been signed between the Hawaiian Mahogany Lumber Company and E. W. Faulkner, representative of the Atchison, Topeka & Santa Fé Railroad Company, for 90,000,000 feet of ohia lumber, which will be cut into 2,800,000 ties and delivered within two years. The price is $2,000,000 at the rate of 71½ cents a tie. It is understood that the Santa Fé will make its own arrangements for shipment and probably will bring from 50 to 75 vessels to Hilo for the freight. This contract also means the establishment of small industries to utilize the by-products, for the shipment of firewood, for making telegraph and telephone pins, charcoal, wagon parts and arms for electric light, telegraph and telephone poles.

DEVELOPMENT OF SILVER FALLS.—The Town Council of Port Arthur, Ont., has authorized the firm of Smith, Kerry & Chace, 126 Confederation Life Building, Toronto, Ont., to commence work on the development of Silver Falls on the Kaministiquia River, about 25 miles northwest of Port Arthur. The development will have an ultimate capacity of about 30,000 hp; the equipment proposed to be immediately installed being 6000 hp. The operating head is about 220 ft. The city has at present in use a development of 1000 hp on the Current River and within the municipal boundaries, but the requirements have outgrown the capacity of this station.

BUSINESS WITH FRANCE.—One of the American consular officers in France sends the name of an electric company there which is open to accept agencies of first-class American electric devices and supplies. Correspondence with this company may be carried on in English. He also sends a list of other firms engaged in this business. The address can be had from the Bureau of Manufactures of the Department of Commerce and Labor, Washington.

UNITED KINGDOM.—An American consul in the United Kingdom states that there is no importing of electrical apparatus at the place in question, but a merchant there, whose name he gives, would like to communicate with makers of such apparatus and thinks it probable that he and others might become importers. The address can be had from the Bureau of Manufactures of the Department of Commerce and Labor, Washington.

ALLIS-CHALMERS STEAM TURBINES.—The Tremont & Suffolk Mills, of Lowell, Mass., will add to the present power equipment, recently purchased, a 1500-kw Allis-Chalmers turbine direct-coupled to a 2000-kw generator, wound for 60-cycle, 3-phase circuits, to operate at a speed of 1800 r. p. m. The new equipment includes in addition to the main unit two exciter units, one motor and the other engine driven 50 kw.

ELECTRIC FANS.—One of the American consuls in Europe gives the name of a business firm in the city in question who would be glad to hear from makers of or dealers in electric fans. The address can be obtained from the U. S. Bureau of Manufactures, Department of Commerce and Labor, Washington.

TELEPHONE MATERIAL.—Bids will be received until Dec. 10 by the Deputy Postmaster-General, Melbourne, Commonwealth of Australia, for the supply and delivery there of fifty telephones, wall sets.

PLANT FOR BRAZIL.—Another step in the development of South America is recorded in cable dispatches from San Paulo, Brazil, announcing that the government has accepted the bid of Guinle & Company, of New York City, to furnish electric power in San Paulo. The electric energy will at first be used for operating the public water works system and later for lighting purposes. Steam plants are very expensive in Brazil owing to the scarcity of coal, and electrical energy generated by water power at a distance has been the solution of the power question. The action of the Brazilian Government in giving this important

contract to an American concern is regarded as of the greatest importance in the development of San Paulo and other cities in that country.

THE NORTHERN ENGINEERING WORKS, crane and hoist builders, of Detroit, Mich., are adding a new power station to their plant. The boiler and coal storage station will be built at once and will be approximately 60 x 60 ft. in size, one story, fireproof construction throughout, with reinforced cement roof, iron doors, etc. It will be equipped with Wickes boiler, Murphy stoker and Webster heater. Contracts have been let. The plans were made by Smith, Hinchman & Grylls, engineers and architects, Detroit.

Financial Intelligence.

THE WEEK IN WALL STREET.—Early in the week the stock market suffered from a severe liquidation due to the calling of loans by banks. Standard railroad shares in particular fell in many cases to the lowest figures in a decade. Speculative buying was generally discouraged by banking authorities. The action of the Clearing House Association in issuing loan certificates and the adoption of similar methods at other cities, together with the violent break in foreign exchange and the announcement of gold imports from Europe to the extent of fully $27,000,000, allayed the panicky feeling and gave assurance that the leading financial interests would be able to control the situation. The buying of metal copper on a large scale was regarded with satisfaction, the effect being shown in the greater firmness of Amalgamated Copper and other copper stocks. The United States Steel Corporation's report for the September quarter was also favorably received, notwithstanding the reported decrease of a million and a half tons in orders on hand Sept. 30. At the close of the week the market was irregular and prices tended downward on the sharp advance in foreign exchange rates. Greater strength was shown in the principal electric stocks and some recoveries from the low figures of last week are noted. Westinghouse was active and advanced 5 points on sales of 3,420 shares. Western Union suffered a decline to the extent of 5 points net and touched the lowest quotation for the year—62. The curb market was narrower, with a little improvement in copper shares. Trading was on a smaller scale and conditions were nearly normal. Following are the closing quotations of Nov. 4:

NEW YORK.

	Oct. 29	Nov. 4		Oct. 29	Nov. 4
Allis-Chalmers Co.....	5¼	5¼	General Electric.....	105½	110
Allis-Chalmers Co. pfd.	14⅛	14⅝	Hudson River Tel....	—	—
Am. Dist. Tel.....	20	—	Interborough Met. com.	5¼	5¾
American Locomotive..	36	39	Interborough Met. pfd	15½	16
Amer. Locomotive pfd.	84	86½	Mackay Cos.	48	48½
American Tel. & Cable.	80*	65	Mackay Cos. pfd.....	53	50
American Tel. & Tel..	—	—	Marconi Tel.	—	—
Brooklyn Rapid Transit	30½	30¼	Metropolitan St. Ry..	22	—
Electric Boat.....	—	—	N. Y. & N. J. Tel....	92	—
Electric Boat pfd.....	—	—	Western Union Tel...	65	63
Electric Vehicle.....	—	—	Westinghouse com.....	50	54
Electric Vehicle pfd...	—	—	Westinghouse pfd.....	—	—

BOSTON.

	Oct. 29	Nov. 4		Oct. 29	Nov. 4
American Tel. & Tel..	97	93½	Mass. Elec. Ry. pfd..	38	39
Cumberland Telephone	—	96¼	Mexican Telephone ...	—	—
Edison Elec. Illum....	197½	188	New England Telep...	100	—
General Electric	106	—	Western Tel. & Tel...	—	53
Mass. Elec. Ry.....	10	9⅞	West. Tel. & Tel. pfd.	—	—

PHILADELPHIA.

	Oct. 29	Nov. 4		Oct. 29	Nov. 4
American Railways ...	44	44	Phila. Electric	6½	6⅞
Elec. Co. of America..	7⅛	8	Phila. Rapid Transit..	16¼	15⅞
Elec. Storage Battery..	33	31	Phila. Traction	85	—
Elec. Stor. Battery pfd	—	—			

CHICAGO.

	Oct. 29	Nov. 4		Oct. 29	Nov. 4
Chicago City Ry.....140		140	National Carbon	55	—
Commonwealth-Edison	79	—	National Carbon pfd..	—	—
Chicago Subway	12	—	Union Traction	—	—
Chicago Tel. Co.....100		—	Union Traction pfd...	—	—
Metropolitan Elec. com.	20*	19*			

*Asked.

WILMINGTON, N. C., CONSOLIDATION.—The control of the Consolidated Railways, Light and Power Company has been transferred to the Tidewater Power Company, under a lease which will continue for 99 years. The terms of the lease were agreed on last July, and the transfer was practically made at that time, but formal ratification of the stockholders on the action of the directors was not gained until now. The purpose of transferring the control of the Consolidated Railways, Light and Power Company to the Tidewater Power Company by purchase of a majority of the stock of the Consolidated Company, and a lease of the Consolidated Company to the Tidewater Power Company for a period of 99 years, is to have an operating company which is large enough and which has sufficient financial strength to take care of the extensions and improvements which have been necessitated by the rapid growth of the city of Wilmington. The Consolidated Company was planned and organized on financial lines which were adequate five years ago, in 1902, but not adequate for the present time, and especially, could not provide for the future.

KEYSTONE TELEPHONE ANNUAL.—The full annual report of the Keystone Telephone Company, of Philadelphia, has just been published for the year ending June 30, 1907. The figures show a surplus of $107,740 after reserves and charges, equal to 5.52 per cent on the $1,936,850 preferred stock of the Keystone Telephone Co. of New Jersey. The statement, with comparisons, follows:

	1907.	Increase.
Gross earnings	$995,752	$165,703
Expenses and taxes.....	522,036	63,081
Balance	$473,716	$102,622
Reserve for renewal and interest charges	365,976	72,100
Surplus	$107,740	$30,522
Adjustments	.....	4,060
Surplus	$107,740	$26,462
Previous surplus.....	423,361	81,278
Profit and loss surplus.....	$531,101	$107,740

A very large amount of development work has been accomplished during the year, involving heavy expenditures. A new line was constructed from Camden to Cape May, two circuits put in operation, and a complete conduit system established in the latter city. Five additional circuits were placed in service between Philadelphia and Atlantic City, requiring 100,000 lbs. of copper wire. This relieved congestion on this line, and greatly facilitated business between Atlantic City and Keystone points in Pennsylvania. It was deemed advisable by the directors to proceed at once to meet the requirements of the public for increased facilities, and it was therefore decided to issue $600,000 three-year 6 per cent collateral trust gold notes. They are secured by $720,000 first mortgage 5 per cent bonds of the Keystone Telephone Company, of Philadelphia.

EARNINGS IN CALIFORNIA.—The combined income account of all the properties owned and controlled by the Pacific Gas & Electric Company, including the California Gas & Electric Corporation, the San Francisco Gas & Electric Company and properties directly operated, for the year ended June 30, 1907, is as follows:

Gross earnings from all sources	$12,164,399
Oper. exp., maintenance, taxes, etc.....	7,016,507
Net income available for bond interest.....	$5,147,892
Int. and sink. funds of subsidiary corporations.....	2,497,414
Surplus available for interest and sinking funds of Pacific Gas & Electric Company.....	$2,650,478
Bond interest and sinking funds Pacific Gas & Electric Company	1,010,673
Balance	$1,639,805
Preferred stock dividends accrued.....	600,000
Balance	$1,039,805

The California Gas & Electric Corporation reports as follows for the year ended June 30, 1907:

Gross earnings	$7,186,133
Operating exp., maintenance, taxes, etc.....	4,062,920
Net earnings from operations.....	$3,123,213
Other income	232,482
Total net income available for interest.....	$3,355,695
Interest	1,724,619
Balance	$1,631,076
Sinking fund	150,000
Surplus	$1,481,076

LOS ANGELES EDISON REPORT.—The Edison Electric Company, of Los Angeles, reports for the year ended June 30, 1907, as follows:

	1907.	1906.	1905.
Gross	$1,989,293	$1,494,500	$1,038,812
Expenses	841,560	606,739	495,214
Net	$1,147,733	$887,761	$588,598
Charges	527,689	348,496	260,729
Surplus	$620,044	$539,265	$327,869

SPRINGFIELD UNITED ELECTRIC.—The United Electric Light Company, of Springfield, Mass., has petitioned the State Gas & Electric Commission for its approval for an issue of capital stock to realize $750,000 for the retirement of floating debt, etc.

AUTOMATIC ELECTRIC.—After a sharp legal and financial struggle terms have been agreed upon by the Strowger Automatic Telephone whereby the company will pass to the control of the Automatic Electric Company. Nearly three-fourths of the stock of the Strowger company is represented by those who formulated and agreed to the plan. Holders of Strowger stock are to receive equivalent to $20 per share in 6 per cent 20-year first-mortgage bonds to be issued by the Automatic Electric Company, covering all of its property. If all the Strowger shareholders assent to the terms, that company will go out of existence, and all its assets, patents and patent rights, both in the United States and in Europe, will become property of the Automatic Electric Company. The deal will be beneficial to all parties concerned, as the Automatic Electric Company obtains by an issue of $1,000,000 additional securities 50,000 shares, or $5,000,000 par value, of Strowger stock, and thus ends an almost endless chain of litigation. The Strowger stockholders receive for their shares a bond at guaranteed interest which figures equal to 1.20 per cent per annum on stock now paying nothing, and the payment of the principal is guaranteed at the end of 20 years. Moreover, the interest return on the new bonds is equivalent to about 12 per cent on Strowger stock at an average of $10 per share, the price at which these securities have averaged in the market over a period of years. Further benefits to be derived by both interests lie in the removal of litigation, which has prevented the closing of many contracts with prospective telephone concerns, whose legal advice has been that if they bought their plants from the Automatic Electric while the Strowger suits were pending, they would be made parties to the litigation and that they might be compelled to honor the royalties which the Automatic Electric had to refuse to pay the Strowger Company.

WESTERN ELECTRIC EARNINGS.—Advices from Boston state that the official estimate of $50,000,000 gross earnings for the Western Electric Company for the year to end Nov. 30, showing a decrease of nearly $20,000,000 from the 1906 total of gross, is in line with the predictions that the decline in earnings would come in the last quarter of the year. For the nine months ended Aug. 31 the gross sales of the company were about 15 per cent less than for the corresponding period of 1906, or, in other words, had averaged at the rate of about $58,000,000 for the year, as compared with nearly $70,000,000 for the previous twelve months. The decrease this year of approximately $20,000,000, or 28 per cent in gross, is the second actual decrease and the first of more than $1,000,000 in the gross sales of the company during the last twelve years. Of the $69,245,331 sales in 1906, about one-third, or say, $23,000,000, was made up of "outside" business. Included in this outside business were sales of every description made to other than American Telephone subsidiary companies. The Western Electric sells considerable amounts of telephone apparatus abroad. In the year 1906 the American Telephone subsidiaries consumed $46,000,000 of the $69,000,000 gross business of the Western Electric Company. This year it is probable that the Bell companies' business will not be more than $30,000,000, this estimate being based on the assumption that "outside" gross will be 40 per cent of the entire total, an estimate which seems conservative in view of the official statement that general electrical business outside of the telephone department is one-third larger than a year ago.

NORTH GEORGIA ELECTRIC.—A bill in equity asking the foreclosure of a mortgage for $481,500 against the North Georgia Electric Company, which is already involved in bankruptcy proceedings, was filed recently in the United States Circuit Court at Atlanta, Ga., by the Knickerbocker Trust Company, of New York, acting as trustees for the holders of 482 bonds which aggregate $482,500 and on which, it is alleged, the North Georgia Electric Company has failed to pay $14,537.50, the amount of interest due Sept. 1, 1907. The court is asked to issue an injunction restraining the North Georgia Electric Company from transferring, encumbering or disposing of any of its property and also to appoint a receiver who shall have an accounting of the company's assets and perform such other duties as usually pertain to his office. Some time ago the president of the company, D. M. Stewart, concurred in a petition that the company be adjudged bankrupt. This step, together with those of other alleged creditors, has been vigorously fought by officials and stockholders, however. Some are of the opinion that there will be a general reorganization of the company, and that, after a slight delay, its work will continue without interruption. The total authorized bond issue of the North Georgia Electric Company amounts to $7,500,000. The $482,500 worth of bonds mentioned above were delivered to the Knickerbocker Trust Co. between Sept. 1, 1906, and July 26, 1907.

DETROIT UNITED RAILWAY.—At Montreal recently the local stock market experienced a panic as the result of the passing of the quarterly dividend on the Detroit United Railways. A rally followed. Mr. H. S. Holt, the only Canadian director of the Detroit United Railway, discussing the action of the board in passing the quarterly dividend, says: "The Detroit United Railway by its charter could not issue bonds for more than 75 per cent of the many improvements and additions that have been made. Even then any bonds issued could be sold only at a ruinous discount and no money could be borrowed under the circumstances now existing in the United States. There remained but one thing to do, and that was to use the profits for betterments. This the directors did, and to do it had to pass the dividend. That does not mean that the property is worth less than when the stock was issued at par. On the contrary, it is worth more, because the system is greater and better equipped than at any previous time and the profits are correspondingly expanding. The road will be in a position to pay a dividend just as soon as financial conditions have somewhat recovered from the present slump, and the passing of the dividend has in no way reduced the value of the stock to those who understand the situation."

NEW HAVEN ELECTRIC LINES.—The fact that the New York, New Haven & Hartford has gone so far in controlling suburban electric lines which compete with its steam lines adds interest to the report of the earnings of its electric lines which the New Haven just submitted in its annual report. The New York Central also has extensive interests in electric lines, but their earnings are not included in the New York Central's annual reports. The New Haven's electric traction lines last year earned $10,638,057 gross and paid out in operating expenses $7,022,158, leaving net earnings of $3,615,899. The electric companies controlled by the New Haven are engaged not only in the business of transporting passengers, but also to some extent in supplying light and power. The detailed statement of earnings submitted in the New Haven's report shows that the earnings of its electric companies included $742,629 earned from the sale of gas, water, electric light and power, and from other miscellaneous sources. These lines also do considerable business in the way of transportation of freight, from which they earned last year $130,581, in addition to $122,786 earned from express business. The earnings from the transportation of passengers reached the large total of $9,410,432.

WESTCHESTER ELECTRIC REPORT.—The annual report of the Westchester Electric Company for the year ended June 30, 1907, is as follows:

	1907.	1906.
Gross	$321,390	$330,033
Expenses	286,746	277,546
Net	$34,644	$52,487
Other income	2,390	2,239
Total income	$37,034	$54,726
Charges	105,835	103,168
Deficit	$68,801	$48,442
P. & L. deficit	581,842	500,000
Betterment	5,043	4,651

HALSEY ELECTRIC COMPANY.—James P. Murray, of Plainfield, and Charles H. and Howard Williams, of New York City, have filed a petition in the United States Court against the Halsey Electric Generator Company, of Jersey City, alleging an indebtedness of $25,550. George R. Beech, of Jersey City, has been appointed receiver for the concern. The petitioners allege that the business of the concern has been on the decline, but a preferential payment was made. The assets of the concern are $25,300; liabilities, $31,052.

MANSFIELD ANNUAL REPORT.—The Mansfield Railway, Light & Power Company reports for the year ended June 30, 1907, as follows:

Gross	$195,631
Expenses	112,087
Net	$83,544
Interest	68,100
Surplus	$15,444

CUMBERLAND TELEPHONE.—The Cumberland Telephone & Telegraph Company reports $4,345,788 gross for the nine months and $1,302,811 net after all charges and taxes. The gross showed a gain of about $400,000.

GENERAL NEWS

Construction News.

JACKSON, ALA.—We are informed that bids will probably be received about Dec. 1 for the construction of a dam across Bassett's Creek to develop additional power for the electric light and proposed water works system of the Jackson Light & Power Company. B. H. Warren is president.

TALLADEGA, ALA.—The city has entered into a contract with the Power Development Company to light the city for the next five years.

KINGMAN, ARIZ.—Plans are being considered to install heavier machinery to be operated by electricity in the Pyramid mills and mines. Charles Sutro and J. F. Littlefield are interested in the project. The Gold Road Company will also modernize and electrify its mill at Little Meadows.

PHOENIX, ARIZ.—The directors of the Octave mine at Congress are considering plans for the enlargement of the mill and installing a new power plant.

GREEN FOREST, ARK.—The Farmers' Union, of Carroll County, has organized a telephone company with a capital stock of $3,000. S. S. Buel is president.

ASHDOWN, ARK.—T. C. Aubrey, of Verda, La., is interested in the organization of a company to establish an electric light and ice plant in this place.

CRESCENT CITY, CAL.—T. B. Cutler, of this city, has been granted a franchise by the Board of Trustees to construct and operate an electric light plant, and to erect poles and wires for the transmission and distribution of electricity on the roads and highways of Del Norte County. The franchise is for a term of fifty years.

GRASS VALLEY, CAL.—F. T. Busch, of Goldfield, Nev., has sold the Ethel mine to a new company, the officers of which are: Major Charles Chralston and B. Goodwin, secretary and treasurer, both of San Francisco. It is the intention of the new company to erect a power plant between the mine and Canyon Creek.

LOS ANGELES, CAL.—The City Council has awarded the two franchises offered for sale at $100 each to Frank W. Flint, Jr. It is understood that he is acting for the Los Angeles-Pacific Railroad.

LOS ANGELES, CAL.—A 600-kw turbine generator at the Edison Electric Company's plant was recently burned out, entailing a loss of about $10,000. Power will be secured from the Huntington plant at Redondo until the generator can be repaired.

LOS ANGELES, CAL.—The Board of Public Works has awarded contracts for the machinery for the city's cement plant at Tehachapi as follows: For two steam turbine sets to the D'Olier Engineering Company for $50,830, the Pacific Coast Manufacturing Company for 26 motors at $13,044 and boilers for $19,550. E. Duryee will have charge of the plant.

NAPA, CAL.—Surveys are being made by the Stone & Webster Engineering Company for an electric railway through Jamison Canyon for the Lakeport & Napa Valley Railroad, which is being promoted by Theodore A. Bell and Richard Hoatling.

OAKLAND, CAL.—E. M. Downer, of Pinole, has filed a petition with the Board of Supervisors for a franchise to establish and maintain an electric light plant for a period of fifty years; also to erect poles and wires along the streets and highways for the transmission and distribution of electricity for all purposes in Alameda County.

OROVILLE, CAL.—The Oroville Water & Light Company is preparing to erect a new plant at Coal Canyon, eight miles above Oroville, where 2000 hp will be developed and provisions will be made to increase the capacity of the plant as required. This plant will also supply Oroville with electricity, power and light.

RED BLUFF, CAL.—The Haze Company has deeded to the Battle Creek Power Company 2380 acres in this county. About 4000 inches of water in Ripley Creek will be used to operate a 2000-kw hydro-electric plant.

RED BLUFF, CAL.—At a meeting of the board of directors of the Pacific Power Company, held recently, J. A. Whitehead resigned both as president and director. Dr. A. P. Tarter was elected president, and Herbert S. Gans as director to succeed Mr. Whitehead. To meet the liabilities of the company it was decided to levy 7 cents a share on all stock outstanding. It is understood that the company will acquire the rights of the Mill Creek Power Company, which, with other developments in view, will give it about 35,000 horse-power.

REDLANDS, CAL.—Work will soon commence on the transmission line between this place and San Bernardino for the Home Gas & Electric Company. The company expects to finish the line by Dec. 1, and to furnish electricity in San Bernardino, Colton and Rialto. The contract is for a term of ten years.

REDDING, CAL.—The Northern California Power Company has purchased the Canyon Creek water right owned by Nils A. Jacobson. The property is in Millville Township and the water right is designed as a feeder for the Kilarc power house on old Cow Creek.

RIALTO, CAL.—The newly organized Rialto Electric Light Company has elected the following officers: I. G. Boyd, president; A. B. Paddock, vice-president; I. F. Martin, secretary. A sub-station is to be erected at once; also the placing of poles for the high line from a connection with the Edison Company to some place near the intersection of Riverside and San Bernardino avenues.

SAN DIEGO, CAL.—The directors of the San Diego Electric Railway Company have called a meeting of the stockholders to consider the question of increasing the capital stock of the company from $500,000 to $5,000,000.

SAN DIEGO, CAL.—Plans are being considered by the Los Angeles & San Diego Beach Railway Company for electrifying its line between this city and La Jolla. It is expected that the power house will be located at Pacific Beach. C. M. Warnecke is chief electrician.

SAN DIEGO, CAL.—The Consolidated Gas & Electric Company has reduced its rates for electricity and proposes to double the capacity of its plant, the work of which will be carried out at once. Orders have already been placed for additional equipment and machinery.

SAN RAFAEL, CAL.—It is reported that petitions will soon be filed by the Snow Mountain Power Company with the Trustees of San Rafael, Mill Valley, San Anselmo, Sausalito and Belvidere for a franchise to construct transmission lines. The company plans to construct a substation in Marion County to supply the various towns. Charles N. Felton is one of the principal stockholders of the company.

STOCKTON, CAL.—Reports have reached this city that the Union Construction Company, which is constructing the reservoirs, power plant and lines of the Stanislaus Power & Water Company, at Camp Relief, Toulumne County, was forced to stop operations Oct. 24 and discharge 1400 men employed at the camps. The reason given was the suspension of the Knickerbocker Trust Company, of New York, N. Y., which was supplying capital for the Union Construction Company. The officers of the company state that the suspension is only temporary. The company has a contract for the construction of the plant of the Stanislaus Power & Water Company, which will cost about $10,000,000, of which $3,000,000 has already been spent.

DENVER, COL.—C. W. Stiff, of Colorado Springs; C. E. Pond, of Colorado City, and Dr. Newton N. Brumback, of Denver, have purchased from the Pikes Peak Hydro-Electric Company the cable railway running from the company's plant in Manitou to the top of the mountain to the west, which forms one of the foothills of Pikes Peak, and are organizing a company to build a scenic railway up to the mountain. The company will be capitalized at $200,000. Electricity will be used as the motive power. The new company will expend about $50,000 on the road, and expects to have it in operation by next summer.

MILFORD, CONN.—At a recent town meeting the citizens voted to appropriate $5,500 for street lighting for the ensuing year. The motion to increase the appropriation to $7,000 was defeated.

TAMPA, FLA.—The directors of the Tampa & Sulphur Springs Traction Company have decided to extend the line into West Tampa, a distance of about four and one-half miles. Material for the new line will be ordered at once.

SAVANNAH, GA.—The City Council has awarded the contract for lighting the city to the Savannah Electric Company.

SPARKS, GA.—At an election to be held soon the proposition to issue $20,000 in bonds for the construction of an electric light plant and water works will be submitted to the people.

POCATELLO, IDAHO.—The Idaho Consolidated Power Company, with a capital stock of $2,000,000, has absorbed the American Falls Power, Light & Water Company, the Pocatello Electric Light & Power Company and the Blackfoot Power & Water Company. James H. Brady will be president of the new company. The plans include the development of 50,000 horse-power at American Falls and transmission of electrical energy to surrounding towns. The plant at American Falls now has a capacity of 2500 horse-power, and 4000 horse-power can be added to the output inside of sixty days.

BRUCE, ILL.—The Bruce Mutual Telephone Company has filed an amendment to its charter increasing the capital stock of the company from $2,500 to $5,000.

SPRINGFIELD, ILL.—John H. Brinkerhoff has declined to accept the amended ordinance for an electric light franchise offered by the City Council, and has presented a statement to the Council asking to be allowed to withdraw the original ordinance, which was granted.

CLAY CITY, IND.—A new plant built and equipped by a stock company will soon begin operation in this city. The streets of the city have been in darkness since the electric light plant was destroyed last May.

EVANSVILLE, IND.—The Evansville & Southern Indiana Traction Company is contemplating the construction of a new city line in the northeastern section of the city.

LAFAYETTE, IND.—The Board of Public Works is advertising for bids for lighting the streets and buildings of the city for a period of ten years. The present contract will soon expire.

HUNTINGTON, IND.—The Fort Wayne & Wabash Valley Traction Company has declined to accept the franchise offered it by the City Council, which provided that 10 per cent of the gross earnings on electricity for light and power should be paid to the city. The company has built a large power plant in Fort Wayne for the purpose of supplying electricity to the surrounding towns and cities. Huntington was the first place in which a franchise was asked.

MICHIGAN CITY, IND.—The Michigan Central Railroad has taken steps to install a heating and electric light plant for the purpose of heating the building by steam and furnishing electricity to light the depot building and premises.

PLYMOUTH, IND.—The City Council has granted the Indianapolis, Logansport & South Bend Electric Railway Company a franchise for a right of way over Michigan Street in this city. It is said that the Logansport-Plymouth division will be built at once.

PRINCETON, IND.—The Princeton Telephone Company has decided to make extensive repairs, improvements and extensions to its system in this city and locality.

SOUTH BEND, IND.—The South Bend & Southern Michigan Railroad Company has entered into a contract with the Indiana & Michigan Electric Company, of this city, to furnish electricity to operate its railway from South Bend to St. Joseph, Mich. The company will abandon its power plant at Scottsdale, which has furnished power for operating the line in the past.

CHICHASHA, I. T.—The Chichasha Water Power Company is contemplating the construction of a dam on the Washita River, near Chichasha, to develop the water power for an electric light and power plant. The company will install two 500-hp water wheels, two 500-hp generators and other necessary equipment. The lighting system will consist of 75 arc lamps of 2000 cp and 3000 incandescent lamps of 16 cp. C. E. Ross is the designing engineer.

SULPHUR, I. T.—A company consisting of White Frost, O. G. Adams, R. S. Bonham and N. B. Ruggles has purchased a tract of land, including the Mystic Cave. The company proposes to enlarge the entrances to various chambers and install a water wheel and dynamo at one of the falls in the cave and light the caverns by electricity and operate boats on the river and lakes, etc.

DAVENPORT, IA.—The J. C. Settle Construction Company, of St. Louis, Mo., has been awarded the contract for the construction of the power house of the Independent Light Company.

IDA GROVE, IA.—The Ida Grove Electric Company has been granted a franchise to operate its system in this place.

KEOTA, IA.—The local electric light plant owned by J. W. Harding has been purchased by William Morris, who has taken possession of the property.

PLEASANTVILLE, IA.—The Swan Telephone Company has applied to the town for a franchise to operate a local exchange. The matter will be submitted to a vote of the citizens on Nov. 18.

LEAVENWORTH, KAN.—The contract for the addition to the electric light and power plant at the Federal prison has been let to E. E. Newberry & Company, for $8,126. The additional equipment will double the present capacity of the prison plant, which is now about 300 hp.

NEW ORLEANS, LA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Nov. 23, for an electric freight elevator in Building 6, naval station, New Orleans. William M. Smith is acting chief.

BUCKSPORT, MAINE.—The Penobscot Bay Electric Company will soon commence work on the construction of a new transmission line between Bucksport and East Orland.

ASHBURNHAM, MASS.—At a special town meeting, held Oct. 29, the citizens voted to issue $10,000 in notes, half of which will be used to purchase the street lighting equipment of the Green Electric Company, and the other half to put it in repair. The power plant of the company was not purchased, as it was decided to purchase electricity from the Gardiner Electric Light Company. The town has decided to make a contract with the Gardiner Electric Company to furnish electricity at the rate of 6 cents per kw-hour. It is expected to have the system in operation about Jan. 1.

HAVERHILL, MASS.—The lighting committee of the City Council has made a new contract with the Haverhill Electric Company for a term of five years. By the terms of the contract the company is to furnish 200 arc lamps for $100 per lamp per year, which is a reduction of $2.50 per lamp paid under the old contract.

MARLBORO, MASS.—The citizens are considering the question of installing an all-night service for street lighting. The streets are now lighted until 1 o'clock in the morning.

MONTAGUE, MASS.—The Selectmen of this village have granted the Franklin Electric Light Company a franchise to erect and maintain a transmission line to Millers Falls for the purpose of furnishing electricity for the electric lighting system. The citizens have voted to abandon the power plant and will purchase electric energy from the Franklin Electric Light Company.

TURNERS FALLS, MASS.—The Franklin Electric Light Company has applied to the State Board of Gas and Electric Light Commissioners for authority to issue $10,000 additional capital stock to retire floating indebtedness.

WEST SPRINGFIELD, MASS.—The Selectmen have awarded the contract to extend the street lighting system by the addition of 10 new lamps and to extend the lines for residential lighting to the Fitzpatrick Electric Company, of Springfield.

CHARLOTTE, MICH.—The Union Trust Company, of Detroit, has filed a bill of foreclosure in its mortgage against the Charlotte General Electric Company. The action was taken on the representation of minority stockholders Messrs. Russell, Campbell, Buckley and Ledyard that interest coupons on $13,000 in bonds had been defaulted. The city recently refused to renew its contract with the company, and this also prompted the present action.

GRAND HAVEN, MICH.—F. W. Weber, superintendent of Public Works, writes that the city will receive sealed proposals for furnishing one 150-kw, two-phase, 2300-volt alternator; one 220-hp engine for direct connection to this alternator; a series alternating-current arc lighting system, complete with switchboard and 100 alternating-current series enclosed arc lamps. Plans and specifications may be secured of the city clerk.

LUVERNE, MICH.—The City Council is considering the question of installing storage batteries in the municipal electric light plant.

POMPEII, MICH.—The citizens of this town and Washington Center have organized a telephone company, to be known as the Washington Center Telephone Company. Frank Cammeth is president.

DULUTH, MINN.—The Great Northern Power Company has installed its second unit of 10,000 horse-power at its power plant on the St. Louis River, above Fond du Lac. The company is now furnishing power to the Duluth-Edison Company, the carbolite works and the Berwind-White coal docks. With the two units in operation the company has ample power for present needs. E. P. Coleman is manager.

FERGUS FALLS, MINN.—It is reported that F. G. Barrows and Vernon Wright are constructing a hydro-electric plant at Dayton Hollow, and are contemplating erecting transmission lines for the distribution of electricity to various places in this vicinity.

KANDIYOHI, MINN.—It is reported that C. E. Kroona is contemplating the installation of an electric lighting plant.

GULFPORT, MISS.—The Gulfport & Mississippi Coast Traction Company has awarded a contract to the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., for the installation of a 1500-kw turbo-generator set, the necessary auxiliary condensing machinery and additional machinery. A. M. Lockett & Company, of New Orleans, La., are the engineers in charge of the work.

NATCHEZ, MISS.—Chancellor Hicks, of the Warren County Chancery Court, upon the application of Harry K. Johnson et al., has granted a decree and appointed W. A. Pollock receiver of the Southern Light & Traction Company, of Natchez, and the Southern Securities Company, of New Jersey. The property will be operated by the receiver, with W. B. Moorman continuing as superintendent. The receivership grew out of the recent litigation, culminating in the decision of the Supreme Court in the case of S. S. Bullis vs. the Southern Electric Securities Company, in which the court held the company to be a trust and combination, and operating here in violation of the laws of the state. The Southern Light & Traction Company also operates plants in Vicksburg, Jennings, La., and Beaumont, Tex.

EDINA, MO.—Geo. W. Newman, the proprietor of the electric light system here, is contemplating establishing a day service, beginning next spring, if enough patronage can be secured to use electricity for operating motors, etc.

PAPILLON, NEB.—The citizens are considering the question of establishing an electric light system.

SCOTTS BLUFF, NEB.—L. L. Raymond, city secretary, writes that J. C. Cain is interested in the construction of an electric light plant in this town, which will cost about $10,000.

WOOD RIVER, NEB.—D. D. O. Kane, village clerk, writes that bids will be received about Jan. 15 for the construction of water works and an electric light plant to cost $17,000. An engineer has not yet been selected.

ATLANTIC CITY, N. J.—The City Council, on Oct. 29, passed the bill appropriating $35,000 for the installation of a new system of illumination for Atlantic Avenue.

GLOUCESTER, N. J.—The City Council has entered into a contract with the Public Service Corporation for lighting the streets for another five years, at the rate of $85 per lamp per year, a reduction of $10 per lamp per year, making a saving of about $7,000 on the contract.

BROOKLYN, N. Y.—C. B. J. Snyder, superintendent school buildings, New York City, on Oct. 28, awarded the contract for installing electric equipment in School 5, Borough of Brooklyn, to T. Fred. Jackson, Inc., 592 Columbus Avenue, New York City, for $15,995.

FORT COVINGTON, N. Y.—The Fort Covington Light, Heat & Power Company is contemplating the construction of a new cement dam. W. S. Keefe is secretary and manager.

FULTON, N. Y.—The Fulton Light, Heat & Power Company will immediately install generators, switchboard and belts. L. W. Emerick is vice-president and general manager.

LANCASTER, N. Y.—The new power house of the Lancaster & Depew Light & Power Company is completed and energy from Ontario will be received soon.

ROCHESTER, N. Y.—Plans have been made by the Rochester & Sodus Bay Railway Company for extensive repairs and alterations to its sub-station either at Sodus or Ontario.

UTICA, N. Y.—F. K. Baxter, of this city, is now at work on map and profile of the proposed electric railway between Hamilton and Norwich.

YORKTOWN, N. Y.—The Northern Westchester Lighting Company, of Ossining, has been granted a franchise to furnish both gas and electricity in the town of Yorktown.

SMITHFIELD, N. C.—We are informed that an engineer will probably soon be selected to prepare plans and specifications for water works, electric lighting plant and sewerage system, and an election will be called to vote on the proposition to issue bonds for the construction of same.

LIMA, OHIO.—It is reported that the Board of Public Service has recommended establishing a municipal electric lighting plant.

GUTHRIE, OKLA.—It is reported that the Fort Smith & Western Railway Company is contemplating converting the St. Louis, El Reno & Western line between Guthrie and El Reno, a distance of forty miles, which it recently purchased, to an electric interurban line. If this plan is carried out by the Fort Smith & Western, an attempt will be made to prevail upon the Rock Island & Santa Fé companies to make the Guthrie-Kingfisher and Guthrie-Chandler lines also electric interurbans.

OKLAHOMA CITY, OKLA.—Plans have been definitely decided upon by the Oklahoma City Street Railway Company for an extension of its Capitol Hill line. The proposed extension will cost about $25,000.

OKLAHOMA CITY, OKLA.—The Citizens' Light & Power Company, recently organized with a capital stock of $250,000, is planning to begin work at once on the construction of a plant to furnish electricity for light and power in the Putnam addition, and later will probably supply the entire city. F. H. Peck, of St. Louis, Mo., will have charge of the construction of the plant.

MILTON, ORE.—The city officials are considering the question of increasing the capacity of the municipal electric light plant. City Recorder Craig has filed on 3600 miner's inches as instructed by the City Council. It is proposed to extend the barrel flume up the river a distance of 5000 feet. By this extension it is estimated that 500 additional horse-power could be secured at a cost of $15,000. This would not include the cost of enlarging the power house and purchasing the necessary additional machinery, which is estimated would cost from $10,000 to $15,000 more.

PORTLAND, ORE.—The Water Board has accepted the offer of the Portland General Electric Company to furnish electric power for the water pump carrying water to Portland Heights, at an estimated cost of $247.50 per month for four months.

TILLAMOOK, ORE.—The electric light plant owned by the Tillamook Lumber Company was entirely destroyed by fire recently, entailing a loss of $5,000.

ALTOONA, PA.—The Citizens' Electric Light, Heat & Power Company has contracted with the Juniata Water Power Company to furnish energy to operate its system for a term of ten years. By the terms of the contract the Citizens' company is to receive all the electricity sent west on its lines, to be delivered at a substation on the outskirts of Altoona. The substation has not yet been built. The contract is to go into effect ninety days from the date of agreement. The Citizens' company is at present installing an 800-hp boiler in its plant, and will extend its lines to the residential and outlying districts around the city.

CRESSON, PA.—The Cresson Electric Light Company is contemplating the installation of an additional 60-kw, 1100-volt, 133-cycle, belt-driven generator to furnish electricity for operating the arc lighting system for street lighting, which will be put in operation Jan. 1. A day service will also be established after that date. The company has a contract with the city to furnish 21 arc lamps of 1200 cp at $60 per lamp per year.

DONORA, PA.—The Donora & Eldora Street Railway Company has secured a right of way for its electric line to connect Donora and Eldora. J. A. Sprowles, of Donora, is one of the incorporators.

HARRISBURG, PA.—The Water Supply Commission has approved the plans of the Mill Creek Water Company, which will operate in Huntingdon County.

PHILADELPHIA, PA.—Director Stearns, of the Department of Public Works, on Oct. 28, awarded the contract for the electrical equipment at the Torresdale filter plant to the D'Olier Engineering Company for $77,002.

PITTSBURG, PA.—The high school committee of the Board of Education has decided to install an electric light plant in the Fifth Avenue High School.

SWATARA, PA.—The Swatara Light & Power Company is considering the proposition of building a dam across Swatara Creek to develop power to generate electricity for light, heat and power purposes.

PROVIDENCE, R. I.—The *Providence Journal* wireless telegraph station at Point Judith was entirely destroyed by fire Oct. 25, entailing a loss of about $5,000.

WESTERLY, R. I.—The Westerly Gas & Electric Company has completed the work of installing an electric lighting system in the boroughs of Stonington and Mystic, and will hereafter furnish electricity for lighting the streets of both places from the Westerly power house.

WOONSOCKET, R. I.—The Woonsocket Electric Machine & Power Company has commenced the work of reconstruction and improvements on its plant, as announced some months ago. A new rotary converter will soon be installed to be used in connection with the railway service. The company will transmit electricity to the sub-station at Lincoln, where power will be furnished to the Providence & Burrillville line.

SPARTANBURG, S. C.—Plans and specifications are being prepared by the Southern Power Company for the construction of a 50,000-hp steam power plant to cost about $2,000,000. The plant will be built in sections as needed, and construction will probably begin during 1908. The plant will be used as an auxiliary, during the low-water periods, to the various hydro-electric plants which the company is building for transmitting electricity in North and South Carolina. The Southern Power Company has two plants completed, furnishing 40,000 hp, and two under construction to furnish 60,000 hp more, and will eventually develop more than 200,000 hp. The main office of the company is at Charlotte, N. C. W. S. Lee is engineer in charge.

SIOUX FALLS, S. D.—The Sioux Falls Light & Power Company is planning to rebuild its entire plant and develop water power to the extent of 2500 hp. H. M. Byllesby & Company, of Chicago, Ill., are the engineers.

SPEARFISH, S. D.—To meet the increase in demand for electricity the Black Hills Traction Company is preparing plans for the construction of a power plant at Beulah, Wyo. The company recently completed a hydro-electric plant, having a capacity of 1200 hp. The new plant will also furnish power for the operation of the proposed electric railway between Deadwood and Spearfish.

NEWPORT, TENN.—The Crescent Engineering Company will enlarge and improve its plant. The company will build a hydro-electric plant of 300 hp, which will include the construction of dam and installation of turbines and necessary machinery to generate electricity to operate its shops and foundry. All the machinery has not been purchased, but the plant is expected to be installed at an early date.

FORT WORTH, TEX.—It is reported that the Tarrant County Commissioners are contemplating the installation of an electric light plant to furnish electricity for lighting the court house and jail.

GALVESTON, TEX.—Extensive additions are being made to the plant of the Brush Electric Light & Power Company. A 500-kw Allis-Chalmers turbo-generator set has just been installed in the power house. The company is also installing another turbine of 1000 kw capacity, a 300-hp motor generator set, one 300-kw rotary converter, two 600-hp Sterling boilers and barometric and turbo jet condensers. A new switchboard has also been installed. In addition to new machinery being installed, the old machinery is being overhauled, by which it is expected to add 600 kw to its output. When the plant is completed it will have an equipment for 500,000 incandescent lamps of 16 cp, which is an increase of 300,000 lamps. The entire city will be rewired. The power house has been enlarged. The cost of the improvements to the plant will amount to about $100,000.

HOUSTON, TEX.—The Houston Electric Company has been granted a 28-year franchise by the commissioners, which will permit the company to extend its lines to a point near Harrisburg.

HUBBARD CITY, TEX.—The Union Central Light & Ice Company has awarded the contract for construction and equipment of its electric power plant and extensions to Mt. Calm, Dawson, Cooledge and Malone to the General Electric Company, of Dallas, Tex.

ESSEX JUNCTION, VT.—Arrangements are being made by the Burlington Light & Power Company to operate the new grist mill of William B. Johnson & Son by electricity, and also the wheelwright shop of H. S. Wood & Son in this place.

BRIDGEWATER, VA.—The Bridgewater Manufacturing Company is planning to build a reinforced-concrete dam, which will furnish 500 additional horse-power to the electric light plant and the Bridgewater mills. It is expected to have the work completed by Dec. 1. James McDonald is superintendent.

ROANOKE, VA.—We are informed that the Roanoke Water Power Company will install a 1000-kw steam turbine auxiliary plant next spring. R. E. Camp is manager.

DEER PARK, WASH.—The County Commissioners have granted a franchise for the Deer Park Telephone system. Louis Olson, A. M. Johnson, D. B. Throop and Antone Iversen applied for the above franchise.

TACOMA, WASH.—Mr. Beall Foster, of the Foster Lumber Company, of Tacoma, writes that he expects to install electrical equipment to generate electricity to furnish light for about 1000 houses, and would like to receive estimates for furnishing equipment for the same.

TACOMA, WASH.—Condemnation proceedings have been started in the superior Court by the Cascade Public Service Corporation for the purpose of securing a right of way through the property of the Nisqually Power Company. The Cascade company represents the Pacific Traction Company's interests and was formed for the purpose of erecting a power plant on the Nisqually River at La Grande to furnish power to operate the Pacific Traction Company's lines and also proposes to furnish electricity for lighting, heating and manufacturing purposes in Pierce, King, Thurston, Lewis and Chehalis counties. The plant will have a capacity of 15,000 horse-power. Ellis, Fletcher & Evans are the attorneys for the Cascade company.

FAYETTEVILLE, W. VA.—E. B. Hawkins, representing the Fayetteville Water & Light Company, now being organized, has applied to the Council for a 50-year franchise to construct and operate an electric lighting and power plant, water works and gas plant.

HAMBLETON, W. VA.—The city has accepted the offer of the Parsons Electric Light & Power Company to light the streets of the city.

SHEPHERDSTOWN, W. VA.—The municipal electric light plant has been sold to John L. Livers for $3,200. The new owner will make improvements to the system, and will soon furnish electricity from the power plant now being built on the Potomac River.

APPLETON, WIS.—John S. Seaman, of Sheboygan, president of the Fox River Valley Interurban Company, states that all surveys for the interurban line from Fond du Lac around the east shore of Lake Winnebago to Kaukauna and Appleton have been completed, and that construction work will commence early next spring. The cost of the new road will be about $600,000.

ASHLAND, WIS.—It is reported that A. E. Appleyard, of Boston, Mass., has purchased a majority of the stock of the Ashland Power & Street Railway Company from Henry F. Blade, of Minneapolis. Thomas Barde, George F. Merrill and other Ashland capitalists own the remaining stock.

LA CROSSE, WIS.—The La Crosse & Winona Electric Railway Company has applied to town officials of Onalaska for a franchise to operate a street railway through the town. The company is making arrangements to secure franchises in the smaller towns, and then will apply for a franchise in Winona. The electric railway is a branch of the La Crosse Water Power Company, which will supply electricity to operate the railway. The La Crosse Water Power Company is building a large dam at Hatfield.

MARINETTE, WIS.—It is reported that a survey is to be made at once for the Holmes Lighting & Power Company for the development of the water power of Grand Rapids for electric power purposes. The work of construction will be started in the spring, and energy transmitted to Marinette and Menominee.

MILWAUKEE, WIS.—The Chicago & Milwaukee Electric Railway Company has filed with the city clerk its acceptance of the franchise recently passed by the Council. The ordinance gives the company permission to use several of the streets on which to operate its cars. A. C. Frost is general manager.

PARDEEVILLE, WIS.—The Fox River Milling & Power Company is contemplating extending its lines and establishing a 24-hour service.

PESHTIGO, WIS.—The large water power plant of the Perley Lowe Company at this place has been completed, and arrangements will soon be made to furnish energy for lamps and motors in this city and Oconto. This plant is the first one of several planned by the company. The second one at High Falls will be finished next spring and will generate electricity, which will be transmitted to Marinette and Menominee.

EDMONTON, ALB.—The City Commissioners are considering the construction of an addition to the civic power plant which will double the capacity of the present plant. A gas producer plant will be installed to operate the engines. Address Mayor Griesbach.

NANAIMO, B. C.—The Nanaimo Electric Light Company will soon commence work on the construction of a large dam at Westwoods Swamp, about three miles from the city, to increase the water capacity for the electric plant.

CAMPBELLFORD, ONT.—The citizens have voted in favor of issuing $60,000 in bonds to develop a municipal electric power plant at Middle Falls.

FORT ERIE, ONT.—Thirty arc lamps are being placed along the river and lake shore drives in the village of Fort Erie. Electricity for operating the system will be furnished by the Canadian Niagara Power Company, which is building a substation at the head of Queen Street. A. Monro Grier, of Niagara Falls, is secretary of the company.

TORONTO, ONT.—Plans of the proposed Niagara Peninsula Railway Company have been filed with the Ontario Railway and Municipal Board, and have been certified by the board. The line will run from Port Colborne through the townships of Humberstone and Wainfleet.

MONTREAL, QUE.—The Southern Counties Railway Company has made application for permission to construct and operate an electric railway from the Victoria Bridge to McGill Street, in Montreal, by the way ot Mill Street and Riverside.

TISDALE, SASK.—The Tisdale Telephone Company is being organized for the purpose of building a telephone line to the settlement of New Osgoode, a distance of 18 miles.

MUZQUIZ, MEX.—The machinery recently ordered for the new electric light plant to be installed in this place has arrived and construction work has been commenced by the company. The equipment of the plant will cost about $40,000 and will have a capacity of 1500 lamps.

Company Elections.

WOONSOCKET, R. I.—At a recent meeting of the directors of the Woonsocket Electric Machine & Power Company, Russell Rodd and Frederick S. Pratt, of Boston, Mass., were elected directors of the company. Mr. Pratt was also elected second vice-president to represent Stone & Webster, who were elected general managers.

VANCOUVER, B. C.—At a recent meeting of the stockholders of the British Columbia Power & Electric Company, organized for the purpose of developing a 250,000-hp hydro-electric plant on the Chekamus River, 48 miles from this city, the following directors were elected: C. Gardiner-Johnson, William Manson, M. L. A.; D. G. Marshall, W. P. Burdie, H. G. Bissett, F. W. Tiffin, C. Fox, J. W. Prescott.

New Incorporations.

MAGNOLIA, ARK.—The Standard Light & Ice Company has filed articles of incorporation with a capital stock of $50,000. The incorporators are: R. L. Moore, J. O. Hutchinson, J. L. Davis and others.

MERCED, CAL.—The Sierra Nevada Electric Company has filed articles of incorporation with a capital stock of $1,000,000. The directors are H. E. Huntington, William Kerkchoff and A. C. Balch, of Los Angeles; J. S. Eastwood and Frank H. Short, of Fresno.

SONORA, CAL.—The Consolidated Stanislaus Water & Power Company has been incorporated with a capital stock of $1,000,000 and the following directors: C. T. Tullock, R. R. Bigelow, W. B. Cadman, C. B. Beise and Anna C. Lane, all of San Francisco.

DENVER, COL.—The Holly Light, Power, Water, Heat & Ice Company has been incorporated with a capital stock of $75,000 by R. H. Graham and others.

BELLEVILLE, ILL.—The Belleville & Interurban Railway Company has been chartered with a capital stock of $100,000 for the purpose of building a railway from Belleville to Smithton. The incorporators are: Jacob Gundlach, Jr., Benjamin H. Gundlach, R. W. Hofsommer, George Hippard and Thomas A. Bell.

CHICAGO, ILL.—Articles of incorporation have been filed for the Chicago, Fox Lake & Lake Geneva Railroad Company with the Secretary of State. The company is capitalized at $2,000,000 and the incorporators are George M. Seward, Sidney F. Mallette, Lewis E. Starr, Maurice B. Louis and Harry Y. Yaryan.

MURPHYSBORO, ILL.—The Murphysboro & Interurban Railway Company has been organized to build an electric railway in and around Murphysboro and to Carbondale. A. B. Minton, Willard Wall, W. C. Alexander, John G. Hardy and P. H. Eisenmayer are interested in the project.

BROWNSTOWN, IND.—The Home Telephone Company has been incorporated with a capital stock of $25,000 by C. E. Brown and others. The company was granted a franchise recently by the City Council.

FT. WAYNE, IND.—The Ft. Wayne Power Company has filed articles of incorporation with the Secretary of State. The company proposes to establish and equip a plant to manufacture and distribute electricity for mechanical power and commercial purposes. Fred H. Schmidt, F. H. Cutshall and L. M. Morris are the directors.

GOSPORT, IND.—The Gosport Electric Light & Power Company has been incorporated with a capital stock of $5,000 by W. A. Montgomery and others.

JEFFERSONVILLE, IND.—The Jeffersonville Independent Telephone Company is asking the Board of Public Works for a new franchise. Jacob Eberts is president.

HARTLEY, IA.—Articles of incorporation have been filed for the Sioux City & Spirit Lake Railway Company with the Secretary of State. The company is capitalized at $50,000. The incorporators are: J. F. Conn, G. E. Kusack, D. A. Fletcher, George Coleman and Frank Patch.

TAMA, IA.—The Columbia Telephone Company has been incorporated with a capital stock of $10,000.

NEW ORLEANS, LA.—The Mamou Power Company has been incorporated with a capital stock of $20,000 by Charles D. Hill, John Clegg and Philip S. Gidere. The company proposes to construct and operate electric light and power plants.

STRONG, ME.—The Strong Lighting & Improvement Company has been incorporated with a capital stock of $10,000 by F. H. Daggett, Charles W. Bell, Diah Sweet, H. J. Bates, P. D. Stubbs, M. A. Will, of Strong, and C. W. Waldron, of Auburn.

COLUMBIA, MISS.—The Columbia Ice & Power Company has been incorporated with a capital stock of $60,000 by G. W. Grayson, of Biloxi; Lee Elder, of Biloxi; L. A. Lundy, of Ocean Springs, and others.

BILLINGS, MONT.—The Yellowstone River Power Company has been incorporated with a capital stock of $500,000 for the purpose of building a power plant to furnish electricity to operate an electric light, and street railway system in Billings. The incorporators are: Christian Yegan, Peter Yegan, Fred T. Mashaw, Fred Inabnit and Charles T. Stewart.

JERSEY CITY, N. J.—Articles of incorporation have been filed with the Secretary of State for the Northwestern Interurban Railway Company. The company is capitalized at $1,500,000, and the incorporators are: H. O. Coughlan, S. A. Anderson and John R. Turner. The company proposes to build an electric railway from Moorhead to Detroit Lake. C. A. Nye is appointed agent and attorney for the company in this state.

WALTON, N. Y.—Articles of incorporation have been filed with the Secretary of State for the Walton People's Telephone Company. The company is capitalized at $30,000, and the directors are: E. Barnum Guild, William J. Cranston and E. L. Jenks, of Walton, N. Y.

KENMARE, N. D.—The Greaves Telephone Company has been incorporated with a capital stock of $150,000 by G. W. Greaves and others.

LEEDS, N. D.—Articles of incorporation have been filed for the Star Line Telephone Company with a capital stock of $5,000 by S. Saunders and others.

DAYTON, OHIO.—The George F. Grove Electric Company has been incorporated with a capital stock of $15,000 by George F. Grove and others.

KNOXVILLE, OHIO.—The Knoxville Rural Telephone Company has been incorporated with a capital stock of $3000 by W. H. McClelland and others.

SEAMAN, OHIO.—The Seaman Bell Telephone Company has filed articles of incorporation with a capital stock of $5,000 by C. E. Kirkpatrick and others.

BRITTON, OKLA.—The Britton & Rural Telephone Company has been incorporated with a capital stock of $3,000 by Dr. B. F. Stewart, Henry Halsey, of Britton, and George W. Collett, of Edmond.

CHOCTAW, OKLA.—The Choctaw City Telephone Company has been incorporated by J. E. McIrvin, T. J. Bowlin and George P. King.

DILL, OKLA.—The Dill Farmers' Telephone Company has been incorporated with a capital stock of $10,000 by W. P. Beam, C. C. Hickman, of Dill; W. C. Larner and George L. Bishop, of Cordell.

HYDRO, OKLA.—The Deer Creek Telephone Company has been organized with a capital stock of $600. The incorporators are Ira Smith and J. P. Jansen.

KERN, OKLA.—The German Telephone Company has been incorporated with a capital stock of $1,500. The incorporators are P. F. Kliewer, P. F. Fransen, H. H. Dyke, John Balster, P. L. Heidebrecht, George Sawatzky and C. F. Nikkel.

OKLAHOMA CITY, OKLA.—The Evansville Telephone Company has been incorporated with a capital stock of $1,500 by W. L. Lambert and others.

SHATTUCK, OKLA.—The Northwestern Telephone Company has been chartered with a capital stock of $15,000 by S. H. James, B. R. James, W. H. Springfield and O. H. James.

SHAWNEE, OKLA.—The Independent Light & Power Company has been incorporated with a capital stock of $150,000 by J. E. Rubey and others.

STELLA, OKLA.—The Farmers' Independent Telephone Company has been incorporated, with a capital stock of $5,000, by J. A. Herring and A. V. Hulse, of Stella, and T. J. Witten, of McCloud.

WINTON, OKLA.—The Highland Telephone Company has filed articles of incorporation. The company is capitalized at $3,600 and the incorporators are Martin Daniel and others.

BUTLER, PA.—Articles of incorporation have been filed for the Butler & Chicora Street Railroad Company with the Secretary of State for the purpose of building a railway from Butler to Chicora and Kaylor, a distance of fifteen miles. The company is capitalized at $90,000, and the directors are: John Daly, of Pittsburg, president; W. C. Criswell, W. J. Horgan, W. G. Stein and E. W. Dervey.

ALAMO, TENN.—The Crockett County Telephone Company has been incorporated by C. H. Scales, L. B. Harwell, Dr. John F. Sanders and others.

UNICOI, TENN.—The Unicoi Telephone Company has been incorporated with a capital stock of $5,000 by J. F. Toney and others.

DALLAS, TEX.—The Delrio Telephone Company has been incorporated with a capital stock of $30,000 by T. C. Sharpe and others.

DEWITT, VA.—The Dinwiddie Telephone Company has been incorporated with a capital stock of $5,000. W. M. Sterne is president.

ROANOKE, VA.—The Roanoke County Telephone Company has been incorporated with a capital stock of $5,000. Monroe Grast is president.

TACOMA, WASH.—Articles of incorporation will soon be filed for a new company, which will be known as the Anacortes Improving & Developing Company. The promoters are: E. S. Morton, W. W. Robinson and R. P. Ball, of Anacortes; Benjamin F. Weeks and H. B. Spear, of Tacoma. The company proposes to construct an interurban railway connecting Anacortes and Sedro Wooley. H. B. Spear will be chief engineer of construction of the new road, and Benjamin F. Weeks, general manager.

Legal.

LIABILITY OF ELECTRIC RAILWAY COMPANY FOR INJURIES RECEIVED AS RESULT OF FRIGHT AT BURNING OF FUSE.—In an action against an electric street railway company it appeared that a passenger on one of the company's cars, becoming frightened at the noise and flame caused by the burning out of a fuse, either jumped or fell from the car into the street, thereby sustaining various injuries. The fuse-box in which the trouble occurred, which might have well been placed under the vestibule or in some equally safe place, was, in fact, attached to the outside sills of the car. It was held that the defendants were liable. They knew the location of the fuse-box. They were aware that the fuse was designed to burn out whenever the wires were overloaded; that no one could foresee such a happening or predict the violence of the explosion and the extent of the electrical display accompanying it, and that passengers were sometimes so frightened by the noise and flame that those in charge of the cars had difficulty in averting accidents. It was incumbent upon the defendants so to equip and operate their cars as to render it improbable that passengers who were themselves in the exercise of care would suffer injury; and this obligation was imposed for the benefit of those whom the defendants either knew, or ought to have known, were liable to be injured by a non-performance of the duty. Lord vs. Manchester Street Railway, Supreme Court of New Hampshire, 67 Atl. Rep. 639.

ELECTRIC RAILWAY COMPANY HELD NOT LIABLE FOR DEATH OF CONDUCTOR STRUCK BY ELECTRIC LIGHT POLE AT SIDE OF TRACK.—An action was brought against the Rhode Island Company to recover damages for the death of a conductor who was killed while climbing around passengers on the running-board of his car by being struck by an electric light pole. In an opinion which reversed a verdict of $5,000 in favor of the plaintiff, the court said upon the question of contributory negligence: "We are satisfied that the plaintiff has not proved that the deceased was in the exercise of due care at the time of the accident. So far as the evidence introduced by the plaintiff is concerned, it does not appear that the deceased conductor, at the time he was on the running-board, took any precautions whatever by looking ahead to see whether he could safely swing out to pass by a passenger standing upon the running-board at the time when he did so attempt to pass and was injured. It must have been known to him that there were poles and trees or similar obstructions all along the line of the road; and, while he would be justified (in the absence of special warning or of actual knowledge) in assuming that he could safely stand and pass along the running-board without danger in the ordinary way, he would not be justified in assuming that he could at any time or place swing out to any distance he might find convenient for the purpose of passing passengers standing upon the running-board. If it became necessary, as it often is, so to swing out and pass, it would plainly be his duty to look ahead and see that he could pass safely in that manner." Negligence on the part of the defendant was claimed on account of the rate of speed at which the car was traveling at the time of the accident, but it was answered that the speed of the car must at all times be subject to the control of the conductor, both because of the duty to obey municipal ordinances relating to speed, and because it might often be necessary to lessen the speed as a matter of safety to the passengers as well as to the conductor himself. He had full right to regulate the speed of the car as he saw fit—to slow down or even to stop, if necessary—in order that he might safely collect his fares. Savage vs. Rhode Island Company, Supreme Court of Rhode Island, 67 Atl. Rep. 633.

LIABILITY OF LIGHTING COMPANY FOR ACCIDENT DUE TO DEFECTIVELY INSTALLED ARC LAMPS.—The plaintiff in an action against a light and power company sought to recover damages for personal injuries received under a novel state of facts. It appears that a furniture company doing business at Waverly, N. Y., employed the plaintiff as a clerk in its store. A main aisle ran from the front to the rear of this store in the centre thereof, over which were suspended three large arc lamps. About three months after the lamps were put up the plaintiff was engaged in sweeping out the store, when the hook holding the lamp in the rear of the store pulled out, thus permitting it to fall suddenly, and the lamp, in its descent, struck the plaintiff upon the head. The result was that the plaintiff, who was alone in the store, was rendered unconscious, and when he revived had no recollection of the falling of the lamp and the blow upon his head; he was found lying on the floor, bleeding profusely from a scalp wound and feeling faint and confused. In regard to the installation of the lamps, the manager of the furniture company testified that he called upon the defendant and it undertook to put arc lamps in the store. It was proved that the furniture company assumed no responsibility whatever as to the lamps. There was no written contract between the furniture company and the defendant company, but the oral agreement was in brief that the defendant company was to remain the owners of the arc lamps—was to place them in position and continue in the exclusive management and control of them; that its representative was to call weekly, keep them in repair, furnish carbons and clean them; and they were to present to the furniture company monthly bills for the use of the lamps and for the services rendered. An employee of the defendant company, who had been selected by it to place these lamps in position, swore that his business was that of a trimmer of electric lamps, and that it was not part of his duties to put up arc lamps, and that there were a number of men there connected with the company whose business it was to install the arc lamps. While no case was cited presenting a precisely similar state of facts, it was held to be clear that the liability of the defendant might be sustained upon well settled principles of law that have been applied to kindred cases. By virtue of its contractual relations with the furniture company, it was held liable to the exercise of reasonable care in placing its own property in the store of the furniture company, for which it was receiving monthly compensation. To this extent the defendant company placed itself in the position of tenant in possession of the store as to all persons lawfully entering it. Fish vs. The Waverly Electric Light & Power Company, *New York Law Journal*, Oct. 24, 1907.

Personal.

MR. GEORGE G. WILSON has been elected a director of the Woodburne Electric Light, Heat & Power Company, of Sussex, N. J., to fill the vacancy caused by the death of his father.

MR. CHARLES E. ANDERSON, formerly of the American Electrical Works, Phillipsdale, R. I., has accepted the position of superintendent with the Westchester Appliance Company, Yonkers, N. Y.

MR. C. C. SCHOEN, of Springfield, Mo., has resigned as general manager of this district of the Ozark Bell Telephone Company to accept a position in the telephone sales department of the Standard Electrical Company, at Cincinnati, Ohio, which is a branch of the Western Electric Company.

MR. FRED McKINNEY has resigned as manager of the Edgerton Telephone Company, of Edgerton, Wis., a position he has held for eight years. Mr. McKinney has been appointed general superintendent of the

toll lines of the Badger State Telephone Company's lines in Wisconsin. Edgerton will be his headquarters for the present.

MR. EDWARD POTTER, superintendent of the Union and the Dartmouth & Westport Street Railway companies, of New Bedford, Mass., has been appointed assistant manager of the Seattle Electric & Power Company, of Seattle, Wash. Mr. Potter will assist in the entire management ot the property.

MR. EDGAR E. STARK, formerly employed as engineer with John Martin & Company on the Pacific Coast as agents for the Stanley Electric Manufacturing Company, and more latterly as engineer with the Waipori Falls Electric Power Company, and assistant engineer with Noyes Brothers, Dunedin, New Zealand, has been appointed city electrical engineer for Dunedin. He assumed the duties of the office on Sept. 28, after having served as acting city electrical engineer for two months. The municipality has a large street railway and electric lighting department.

MR. BION J. ARNOLD has arrived in this city from Chicago to take up his special work as a consulting engineer for the Public Service Commission. He is in much better health and has practically recovered from his serious accident of last summer. He is to prepare a report upon the equipment and operation of the subway, and to advise the commission how the service may be increased—how a greater number of trains and cars may be run and how the movement of passengers may be facilitated. If he considers it advisable to recommend a new type of car or the reconstruction of the present cars he is at liberty to do so. No restrictions have been imposed, and the commission expects and desires a full report suggesting anything that, in his opinion, will increase the service of the subway and the comfort of the passengers. It is expected that the report will be filed very soon.

MR. GEORGE WESTINGHOUSE.—A very interesting review of the life work of Mr. George Westinghouse appears in the *New York Times* of Nov. 3. It begins as follows: "Westinghouse could make brakes to stop every railroad train in the country, but he couldn't brake himself. He could invent signals so perfect that a mile a minute became a commonplace railroad speed, but when he was running himself far beyond that clip he wouldn't even look out of his cab window to see if the financial danger signals were up. In this way a wise old Wall Street man accounted one day last week for the temporary check that came to George Westinghouse in the appointment of receivers for several of the great enterprises in which he is the dominating factor. Not that the financier thought for a moment that Westinghouse had been wrecked; he knew the man too well, even if his familiarity with the conditions of the receivership had not been sufficient to contradict any supposition of that order."

Trade Publications.

LIDGERWOOD MANUFACTURING COMPANY, 96 Liberty Street, New York City, has issued a quarto four-page bulletin on its slip-drum electric winches for hauling in car floats. The device operates under the control of one man. The winch was first adopted by the Pennsylvania Railroad and is now being generally introduced.

POND TURRET LATHE.—The Niles-Bement-Pond Company has issued a 44-page catalogue devoted entirely to the Pond rigid turret lathe, a machine designed for producing work ordinarily done on engine lathes, and especially adapted to such work as gear blanks, fly wheels, gas engine cylinders, etc. A large number of illustrations show different types of the lathe and of its application to various classes of work.

AUTOMATIC REFRIGERATION.—The Automatic Refrigeration Company, Hartford, Conn., has issued a folder in which is pointed out in concise form the advantages of its system of automatic refrigeration. In this system the apparatus is run by an electric motor in connection with automatic devices, so that the instant a desired temperature is reached, the system suspends operation and all expense ceases.

MINNEAPOLIS STEEL & MACHINERY COMPANY, of Minneapolis, Minn., has issued in a very neat little pamphlet a clever article by Elbert Hubbard on the Mammoth Cave, now in its innocuous desuetude. It is called "What Happens When Advertising Stops" and is well worth reading. Besides for so small a pamphlet it carries a very big moral. Incidentally there is some engine data and a word about the Twin City heavy duty Corliss engine.

THE PITTSBURGH TRANSFORMER COMPANY has issued for October a very interesting folder, giving some data as to how many of its transformers fail from various causes and have been returned to the factory. The number in 1906 was only 43, and thus far in 1907 the number is only four. In 1899 is was twelve. The gain in output has been 50 to 80 per cent in same years. The test of time and endurance is evidently a good one for the Pittsburgh Transformer Company.

NERNST LAMP COMPANY, Pittsburg, Pa., has recently issued a most dainty little pamphlet called "Lux," comprising several issues of the miniature magazine bearing that name devoted to the introduction of the Nernst lamp by the process of reasoning and argument. Another handsome and interesting publication is that entitled "Bank and Office Lighting by Electricity," just issued, which describes and illustrates a number of installations in which the Nernst lamp has proved its merits and special uses.

THE CRESCENT COMPANY, of Valparaiso, Ind., has issued circulars descriptive of its protector lamp guards, of which it makes a specialty. These are manufactured in a large variety of shapes, sizes and styles of finish. The company has also a line of novelties in its portable guard, its "Innovate" cord adjuster; the Crescent time switch; coloring fluid and lamp frosting; soldering paste; electric flasher, universal cord spools; toggle bolts, etc., and its literature illustrating and describing these will be gladly sent to any address upon application.

MERCURY-VAPOR RECTIFIERS.—Much information concerning the installation and operation of single-phase mercury-vapor current rectifiers. is given in circular No. 1148 of the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. The rectifiers are built for ratings of from 40 to 120 volts and from 5 to 30 amperes on the output side. It is stated that at the maximum e. m. f. the efficiency is more than .80 and the average power factor at any e. m. f. is approximately .90.

VICTOR COMBINATION METERS.—The H. W. Johns-Manville Company, 100 William Street, New York, has issued a handsome catalogue illustrating and describing the Victor combination meter and its auxiliaries. This interesting type of meter, which is a direct-current instrument, is a combination of a voltmeter, ammeter and wattmeter. One of the two hands plays along an ampere scale, the other hand along a volt scale, and the intersection of the two hands comes over a watt scale, the latter occupying the central portion of the dial.

ELECTRIC LIGHTING LITERATURE.—Several thousand copies of the "Electric Jingles" and "When the Sad Iron Smiled," written and issued by Miss C. Beckwith, have been sold to central station companies, and a number of large orders have been received during the past month. Both text and illustrations of these clever brochures render them excellent matter for public distribution in any "electricity sales" compaign, while their low price is quite a consideration. Sample copies and prices can be had upon inquiry addressed to her office at the Flatiron Building, New York City.

FRANKLIN BULLETIN.—The Franklin Electric Manufacturing Company, Hartford, Conn., has issued its Bulletin No. 3 giving some points concerning its Novi and Femco incandescent lamps. The bulletin is handsomely gotten up. It is printed in colors, each page having an artistic head and tailpiece, and illustrations show the general construction of the lamps above named, besides other subjects. The front cover is of artistic design and attractively colored. The bulletin was gotten up especially for distribution at the Atlantic City convention of the Street Railway Association this week.

GOULD STORAGE BATTERY COMPANY, 341 Fifth Avenue, New York City, has just issued a third revised edition of its excellent pamphlet devoted to a description of its Gould storage battery plates, entitled "Facts." This is a compilation of good technical data. It has also issued for October two quarto pamphlets, one devoted to the storage battery plants of the Dayton & Western Railway, and the other to the plant of the Rutland (Vt.) Railway, Light & Power Company, in which the Gould batteries are used in conjunction with rotaries and the alternating current system, to a total capacity of 1100 amperes.

BLAKE SIGNAL & MANUFACTURING COMPANY, 246 Summer Street, Boston, Mass., has issued a handsome and interesting pamphlet, entitled "Requirements for Efficient Telephone Train Dispatching." It deals with the Blake telephonic apparatus and methods for this purpose, and brings out their superiority to the telegraph. A number of testimonials are quoted from traction companies embodying their experience with the system. The front and back covers, outside pages, show the signal itself, in red, in and out of operation, as governed from the dispatcher's desk. The full modus operandi is carefully explained.

MERCURY ARC RECTIFIERS.—Mercury arc rectifiers are the subject of Bulletin No. 4530, issued by the General Electric Company. A brief outline of the theory of the apparatus is given in the bulletin, and various types of rectifying sets are described and illustrated, including ignition battery charging outfits for gasoline automobiles; internal combustion engines, etc.; small motor rectifier outfits for supplying direct current for small dental motors, etc.; garage panels for charging vehicle batteries, and standard commercial outfits for charging storage batteries in general, operating arc lamps, searchlights and similar apparatus, for railway signal systems, electroplating, etc.

HEATING AIR AND WATER.—A 16-page booklet has recently been issued by the Green Fuel Economizer Company, of Matteawan, N. Y. The first seven pages of the booklet are devoted to a reprint of an article by Herr C. Eberle, of Munich, on "The Influence of Boiling by Steam on the Boiler Plants of Breweries," in which it is shown that the highest economy is reached only when both the exhaust steam from the different machines about the brewery and the waste gases from the boiler furnace are utilized for producing hot water. An example is fully worked out with diagrams and layout of machinery to show this. The second part of the pamphlet takes up the use of warm or cold and moistened air for promoting germination, and of the use of hot dry air in the malt kiln. By utilizing blowers to move this air, much quicker and better results may be obtained than by methods relying upon natural draft. It is also possible to run the plant to full capacity at all times of the year and in all conditions of the weather.

WRIGHT DEMAND INDICATORS.—Bulletin No. 4533, of the General Electric Company, is devoted to the Wright demand indicator, which has been extensively adopted for central station meter service, and is also used in determining load factor, the maximum output of generators, transformers, feeders, etc. It consists of a small differential thermometer, having one of its bulbs surrounded by a heating band carrying all, or a definite shunted part, of the total current. The expansion of air in this

bulb forces the liquid in the "U" tube of the differential thermometer into the opposite leg and causes it to overflow into a central or index tube connected to the upper end of the "U." The height of the liquid in the index tube is read on the indicator scale and marks the maximum demand of the circuit. The bulletin describes and illustrates the several sizes of instruments manufactured, together with capacities, prices, dimension diagrams, scales, etc.

H. T. PAISTE COMPANY has issued an attractive number of "Paistery" for October, dealing with its specialties in weatherproof plugs, Paiste rosette sockets, bracket Fielding rosettes, panelettes, etc.

MOTOR RHEOSTATS.—Rheostats for motor starting purposes and for varying the field strength of shunt connected motors are described and illustrated in circular No. 1139, of the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa.

LIGHTNING PROTECTIVE APPARATUS.—A good discussion of lightning phenomena and of the apparatus that may be employed for protecting electrical disturbances is given in circular No. 1132 of the Westinghouse Electric & Mmanufacturing Company, Pittsburg, Pa.

BRONZE.—The Ansonia Brass & Copper Company, 99 John Street, New York, has issued a booklet describing tests and applications of Tobin bronze. Tobin bronze is remarkable for its high elastic limit, tensile strength, hardness and uniform texture. It is adapted for a variety of purposes where a strong non-corrosive metal is required.

CONTROL RESISTORS.—Circular No. 1122, of the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., deals with grid type resistors for use with railway motor equipments. The resistors are formed of cast-iron grids, insulated at the supporting points by means of mica.

DIRECT-CURRENT MOTORS.—Two-pole motors rated at from .5 hp to 1.5 hp and four-pole motors rated at from 2.5 hp to 12.5 hp are described in Bulletin No. 147 of the B. F. Sturtevant Company, Hyde Park, Mass. Eight-pole motors rated at from 7.5 hp to 225 hp are discussed in Bulletin No. 144 of the same company.

BENJAMIN SPECIALTIES.—The Benjamin Electric Manufacturing Company, Chicago, has just issued a supplementary bulletin containing additions and changes affecting its catalogues B-17 and B-17A. A number of new devices worthy of the attention of the lighting fixture trade are listed therein.

CONTROLLERS FOR CRANE AND HOISTING MOTORS are described in circular No. 1143, of the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. The controllers are designed for regulating the speed and reversing the direction of rotation of series-connected and compound-connected direct-current motors.

ELECTRO-STATIC VOLTMETER.—Folder No. 4086, of the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., describes a type of electro-static voltmeter for which it is claimed that it eliminates the faults common to the ordinary construction, and represents the most convenient and satisfactory apparatus available for high-pressure measurements.

ELECTRIC MACHINERY COMPANY, of Minneapolis, Minn., has recently issued bulletins Nos. 77 and 84. The former illustrates and describes its direct current motors and generators, while the second deals with its revolving field alternating current generators. Very full details are given. The company has also issued a list of 100 first-class institutions using its apparatus.

DIELECTRIC COMPANY OF AMERICA, of Belleville, N. J., has just issued a circular on underground transmission, in which its system of conduits with bridge blocks of porcelain and fibre, protected with insulating compound, is fully explained. A number of testimonials are included as to the Dielectric compound, and the whole system is fully illustrated in detail.

TIME STAMP FOR TELEPHONE TOLL LINE SWITCHBOARDS is fully described in a booklet recently issued by the Automatic Time Stamp Company, 160 Congress Street, Boston, Mass. The stamp prints the hour, minute and second, a. m. and p. m., and the day, month and year, when a telephone toll line conversation begins and when it ends, and it computes and records the elapsed time to a second.

IDEAL ENGINES.—The latest edition of the catalogue of the Ideal engine, made by A. L. Ide & Sons, Springfield, Ill., is a handsome specimen of trade literature. The Ideal engine is described in complete detail in connection with admirable illustrations and a number of full-page cuts showing application, most of the latter views being of direct-current generating units.

STEAM GAUGES.—The Williams Gauge Company, Pittsburg, Pa., has issued an exceptionally well worded illustrated folder, entitled "Two Hundred Per Cent Investments," more than one-half of which is devoted to a discussion of economy in business and the remainder of which deals with economy in steam production. The 200 per cent investment relates to the purchase of steam-boiler appliances that save in coal an amount per year equal to twice the total cost of the appliances.

CATENARY LINE MATERIAL.—In Bulletin No. 4538, of the General Electric Company, 32 pages are given to a very complete description of the devices manufactured for catenary overhead construction. A great many new designs in frogs, crossings, hangers, etc., have been made necessary, and numerous illustrations of separate parts as well as of complete installations are of immediate interest. The system consists essentially of a slack messenger cable, from which the trolley wire is supported by means of special hangers so distributed as to maintain it practically without sag between suspension points. The catenary system offers mechanical advantages of longer pole spacing and straighter trolley wire and a flexibility in the line which avoids the hammer blow of the collector at suspension points and reduces the danger of mechanical breakage.

THE NAVY BULLETIN.—A booklet which should prove exceedingly useful to all who sell electric motors or motor-driven machinery to the Navy Department has just been issued by the Cutler-Hammer Manufacturing Company, of Milwaukee, maker of electric-controlling devices. This company for many years has made a special study of Navy Department requirements, and in this booklet full descriptions, illustrations, dimension diagrams and shipping weights are given on starting panels, speed-regulating panels, machine-tool controllers, resistances, circuit-breaker panels, etc. In the preface to the booklet in question attention is called to the fact that navy specifications preclude in nearly all instances the use of ordinary controlling panels, and, furthermore, that apparatus acceptable for use in navy yards will not always be acceptable if supplied for use on shipboard. How to select the proper piece of apparatus in each case is fully explained, and in addition to numerous illustrations of electric-controlling appliances conforming to Bureau of Construction and Repair and Bureau of Equipment specifications, the booklet includes several views of battleships equipped with Cutler-Hammer controllers.

MOTOR-STARTING RHEOSTATS.—The General Electric Company describes in Bulletin No. 4532 some recently perfected lines of direct-current motor-starting theostats in ratings up to 50 hp and 550 volts. Type SA rheostats are made for one-minute duty, with no-voltage release, and are suitable for use with shunt, compound or series-wound motors. Type SO are similar to type SA, but have in addition to the no-voltage release attachment an overload coil in series with the motor armature. Slight variations in design are made for rheostats of different capacities in order to meet more suitably required conditions, and the bulletin illustrates the various styles. An improved type of resistance unit, known as the Form P, is used in the smaller capacities. This is an enclosed unit made of low-temperature coefficient resistance wire wound on a strong tube. The tube is not brittle and is treated with a special compound, which forms a coating both inside and out, thus reinforcing it and making a very strong and solid construction. The unit is afterward thoroughly baked, and when completed is claimed to withstand very rough usage.

CURTIS STEAM TURBINES.—In Bulletin No. 4534, recently issued by the General Electric Company, horizontal shaft type Curtis steam turbine sets up to 300-kw capacity, both direct current and alternating current, are described, as arranged to operate either non-condensing or condensing. The generators have commutating poles and special commutator construction, particularly adapting them to continuous operation with little attention. Among the advantages pointed out are that these turbines require less floor space than any type of horizontal engine and about the same floor space as vertical engines, but have much less height. Owing to their light weight, small size and the absence of reciprocating parts, massive foundations are unnecessary. These features, together with the small attendance required and the smoothness of operation, make them particularly suitable for supplying light and power in mills, machine shops, laundries, apartment houses, for heating and lighting plants on steam vessels, office buildings, railway stations and for train lighting. They are also extensively used for exciting alternating-current generators in central power stations.

ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has just issued two new bulletins. One of these is devoted to the chloride accumulator for alternating current regulation, with a split pole variable ratio converter developed by the company and with its carbon regulator. The other pamphlet describes such regulation as applied to the single-phase system of the Spokane & Inland Railway. Mr. J. B. Ingersoll, general manager of the company, in consultation with the engineers of the Electric Storage Battery Company, conceived the idea of combining in one piece of apparatus an induction motor to operate from the supply power, a single-phase generator to deliver the required power to the load and a direct current machine to act either as a generator or a motor, according to whether the railway load is momentarily below or above its average value, the three machines being direct connected and mounted on a common bed plate. The direct current machine gives power to or takes power from a battery of "chloride accumulators" connected across its terminals in series with a regulating booster controlled by the carbon regulator. The latter is operated by the alternating current in the 60-cycle supply line, and insignificant changes of current in this line acting on the regulator cause the battery to charge from or discharge into the direct current machine and relieve the line of the load fluctuations. The action of the combination is as follows: The single-phase generator delivers current to the railway according to the demand, power for driving it being furnished by the 60-cycle, three-phase induction motor so long as the railway load is equal to the average. Under this condition the battery "floats" across the direct current generator, neither charging nor discharging. As soon as the railway load falls off, however, the carbon regulator causes the direct current machine to charge the battery and take the surplus power from the induction motor. On the other hand, when the railway load increases beyond the average, the

direct current machine immediately inverts and runs as a motor to assist the induction motor, drawing power from the battery, which, of course, is forced to discharge. The action of the carbon regulator in maintaining a constant load has been so often described that nothing need be said on this point here, except to add that by a proper design of its actuating solenoid it can be made to act as effectively on alternating current as on direct current systems.

Business Notes.

THE BALL ENGINE COMPANY, Erie, Pa., has opened a sales office at 1001 Arcade Building, Philadelphia, Pa., under the management of Mr. H. P. Penfield, that it may be better able to handle the growing demand for its automatic and Corliss engines.

FAHN & McJUNKEN, 201 East Sixteenth Street, New York, have been appointed agents for the Fleuss vacuum pumps, made by the Pulsometer Engineering Company, 61 Queen Victoria Street, London, E. C., England, for the exhaustion of incandescent lamps.

THE SUTHERLAND MANUFACTURING COMPANY, of Cincinnati, Ohio, manufacturers of gas and electric fixtures, has closed negotiations by which its business will be merged with that of the Black & Boyd Manufacturing Company, of New York, N. Y., and the business will be transferred to New York on Jan. 1.

THE ALLIS-CHALMERS COMPANY has opened an office at Deadwood, S. D., with Mr. O. F. Purnell as district manager. Special attention will be given by Mr. Purnell and the members of his staff to the sale of mining, crushing, pumping, power and electrical machinery, many installations of which have been made by the Allis-Chalmers Company and its predecessors throughout that section of country.

THE DEAN ELECTRIC COMPANY has recently increased its power facilities for manufacturing purposes by the installation of two Crocker-Wheeler generators—two complete units operating independently—and a four panel switchboard built for handling the total output of 600 kw. The generators are direct coupled Ball type, horizontal cross-compound engines which receive steam at a pressure of 600 lbs. per sq. in. from boilers of the Stirling type.

ALLIS-CHALMERS BRASS FOUNDRY.—The brass foundry department of Allis-Chalmers Company's works at Cincinnati, Ohio, is one of the best arranged and equipped in the country. This department turns out 50,000 pounds of castings and upward per month, and it is necessary to produce a large variety of work, including brass, bronze and aluminum, also various special alloys. The foundry at present employs about sixty men. A large proportion of the molds are put up on Tabor machines, which are situated at one end of the foundry, the molds being carried back and arranged in rows down the length of the floor. The sand tempering and mixing machinery is arranged in the center of the room. The cleaning department is also located in the center. This places the molding floors on the sides nearest the windows where the best of light is obtained. A trolley track is arranged over the floor where the heaviest work is made for handling both molds and metal. The cleaning department is equipped with metal band saws and all of the other machinery necessary for cleaning the castings. A large proportion of the castings made are very light and intricate in form, so that the number of pounds produced is but a small indication of the amount of work necessary to turn them out. This is especially true of the bench work and floor molding. A large amount of aluminum castings is also turned out. Aluminum castings, weighing over 700 pounds and some 12 feet in diameter, have been made here. Most of the metal is melted in a battery of four Monarch oil furnaces, which are fired with crude oil. There is no difficulty whatever in melting aluminum or any of the other alloys in furnaces of this type. For special alloys a battery of seven crucible furnaces is provided. Back of the crucible furnaces there is a core oven which is heated by the waste heat from these furnaces. The core department is also situated back of these furnaces, so that the cores can be placed in the oven as soon as they are finished.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCT. 29, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

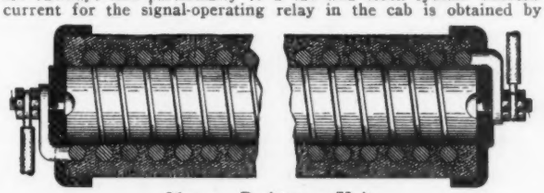
869,229. MOTOR CONTROL; E. R. Carichoff, East Orange, N. J. App. filed Jan. 28, 1904. A system for controlling electric motors particularly designed for elevators, and having contactors controlled by a pilot circuit.

869,243. ELECTRICAL SYSTEM OF DISTRIBUTION; A. S. Hubbard, et al., Greenwich, Conn. App. filed March 31, 1905. Relates to electrical systems of distribution employing a branch circuit containing storage batteries to steady the load on the main generators, and automatic means for regulating the battery current to make the generator load constant within close limits.

689,244. ELECTRICAL SYSTEM OF DISTRIBUTION; A. S. Hubbard, et al., Greenwich, Conn. App. filed July 2, 1906. Relates to modifications of the above.

689,248. ENGINE-STOP VALVE; J. L. Kimball, Salem, Mass. App. filed June 20, 1906. A spring-impelled puppet valve normally kept in open position by a magnet which is de-energized to release the valve member.

689,275. BLOCK-SIGNALING SYSTEM; L. H. Thullen, Swissville, Pa. App. filed May 15, 1907. Relates to electric-signaling systems for railways and particularly to a cab and block system wherein the current for the signal-operating relay in the cab is obtained by induction from a wire or other conductor extending parallel to the track.



869,314—Resistance Unit.

869,276. PROCESS OF REDUCING COMPOUNDS WITH ELECTRICALLY DEVELOPED HEAT; F. J. Tone, Niagara Falls, N. Y. App. filed Sept. 22, 1906. The process of producing silicon, which consists in subjecting a mixture containing silica and a compound containing silicon, oxygen and carbon to electrically developed heat, and reducing the silicon thereby to its elemental form.

869,279. ELECTRICAL SYSTEM OF DISTRIBUTION; E. Van Wagenen, New York, N. Y. App. filed July 2, 1906. Relates to electrical systems of distribution and the automatic regulation of the same. Has a storage battery and a booster employed in connection with a rotary vertical or other rectifier device to steady the load on a main alternating current generator.

869,286. ELECTRICAL SYSTEM OF DISTRIBUTION; W. E. Winship, New York, N. Y. App. filed March 7, 1907. Relates to electrical systems of distribution employing an electric storage battery to steady the load on an alternating-current generating plant. Provides means by which the battery is controlled respectively to the power variations of the alternating-current generator by varying the electromotive force of a booster in series with the battery.

869,300. ARC-LAMP ELECTRODE; Richard Fleming, Lynn, Mass. App. filed Nov. 22, 1902. An arc lamp electrode consisting of an iron tube filled with iron particles.

869,301. ARC-LAMP ELECTRODE; Richard Fleming, Lynn, Mass. App. filed March 26, 1903. An electrode consisting of an iron tube filled mainly with iron oxid.

869,306. ELECTRICAL SYSTEM OF DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed June 20, 1906. Relates to alternating-current systems of distribution supplied by an alternating-current generator and especially to the arrangement therein of a special character of transformer connected to a regulating circuit.

869,314. RESISTANCE UNIT; Campbell Macmillan, Schenectady, N. Y. App. filed Dec. 1, 1905. A resistance unit comprising a material having a negative temperature co-efficient, and a resistor having a positive temperature co-efficient embedded therein.

869,317. APPARATUS FOR CEMENTING THE FILAMENTS OF ELECTRIC LAMPS TO THE STEM WIRES; N. Marshall, Newton, Mass. App. filed July 27, 1906. Has a stem-holding device, a filament-holding device, and means operating to cause a relative movement between the devices which brings a wire and filament end into juxtapositon.

869,318. APPARATUS FOR CEMENTING THE FILAMENTS OF ELECTRIC LAMPS TO THE STEM WIRES; N. Marshall, Newton, Mass. App. filed Feb. 8, 1906. Relates to modifications of the above.

869,321. INSULATING MATERIAL AND METHOD OF MANUFACTURING SAME; Robert Muller, Munich, Germany. App. filed Jan. 6, 1905. An insulating composition comprising a fragmentary mineral fireproof material united by filmiform layers of a pitchy substance having a relatively high fusing point.

869,348. STORAGE-BATTERY GRID; R. N. Chamberlain, Depew, N. Y. App. filed Feb. 5, 1906. In order to have a mechanically stronger storage-battery electrode, and one which is also electrolytically superior, patentee rolls the lead base plate with deep, narrow, V-shaped grooves in which the active material is imbedded.

869,352. MOTOR-CONTROL SYSTEM; M. W. Day, Schenectady, N. Y. App. filed March 6, 1907. Has an electric motor adapted to drive the load at low speed, a second motor adapted to drive the load at a higher speed, and means for controlling the circuits of the motors to operate in a definite sequence.

869,356. MOTOR CONTROLLER; Wilhelm Fiedler, Berlin, Germany. App. filed April 3, 1906. Relates to devices for controlling electric motor circuits and provides means by which the motor may be retarded or quickly brought to rest in a reliable, safe and efficient manner. Has a centrifugal device on the motor armature.

869,359. RELAY FOR CIRCUIT BREAKERS; Max Fuss, Berlin, Germany. App. filed Aug. 26, 1904. Relates to relays for use in connection with circuit breakers and the like, and has mechanism by which the circuit may be broken instantaneously upon an excessive voltage, or after an interval upon a slight voltage, and also upon a reversal of power.

869,364. AIR-BRAKE SYSTEM; L. A. Hawkins, Schenectady, N. Y. App. filed Feb. 3, 1906. Electrically operated air-brake system having magnet operated valves.

869,365. BLOCK-SIGNAL SYSTEM; L. A. Hawkins, Schenectady, N. Y. App. filed March 28, 1906. A block-signal system for electrically operating roads employing the rails as return conductors for power current. Has inductive bonds for connecting the block sections.

869,368. ADJUSTABLE SUPPORT FOR TELEPHONE RECEIVERS; Ross Higgins, Canfield, Ohio. App. filed Feb. 27, 1907. Tubular-holding device for telephone receiver.

869,398. AUTOMATIC DEVICE FOR PROTECTING TRAINS; E. Unvericht, Altona, Germany. App. filed Jan. 8, 1906. Automatic means for protecting railway trains and controlled by electric circuits. Designed to prevent a collision of trains running in opposite directions along the same line. Covers details of construction.

869,403. STRAIN INSULATOR; Albert Anderson, Boston, Mass. App. filed March 2, 1906. A strain insulator having a metallic shell enclosing insulating material in which the terminals of the conductors are imbedded.

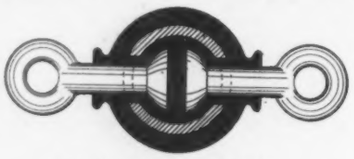
869,404. STRAIN INSULATOR; Albert Anderson, Boston, Mass. App. filed July 5, 1906. Relates to modifications of the above.

869,409. ALARM ATTACHMENT FOR INCUBATORS; C. E. Benedict, Kansas City, Kan. App. filed March 10, 1906. Relates to electric alarm attachment for incubators. Has thermostat device which operates to close the switch of an alarm circuit.

869,410. INSULATING COUPLING; A. W. Berresford, Milwaukee, Wis. App. filed Feb. 21, 1903. Two shafts are connected by slotted blades with intermediate insulating material.

869,413. FREQUENCY CHANGER; W. S. Bralley, Schenectady, N. Y. App. filed Feb. 5, 1907. Relates to frequency changes and provides means for tying together two transmission systems of different frequency so as to enable one system to supply power to the other.

869,420. PRINTING TELEGRAPH; B. W. Cochran, Los Angeles, Cal. App. filed April 19, 1905. Printing telegraph of the type in which



869,403—Strain Insulator.

a plurality of printing magnets are selectively operated by a series of impulses, each of said magnets being brought into operation by a series of impulses having distinguishing characteristics.

869,432. ELECTRIC FURNACE; G. Gin, Paris, France. App. filed Jan. 25, 1906. A furnace designed to simultaneously and uninterruptedly effect the several operations which occur in the production of steel, namely, fusion, oxidation of impurities, reduction of the dissolved oxid of iron, and carburization.

869,446. PROCESS FOR MAKING DRY CELLS; P. L. Meyer, New York, N. Y. App. filed Feb. 19, 1906. The zinc casing of the dry cell is revolved on its axis so as to cement the plaster coating uniformly on its interior wall by centrifugal force.

869,449. MEASURED SERVICE SYSTEM FOR TELEPHONE LINES; J. L. McQuarrie, Oak Park, Ill. App. filed Feb. 23, 1906. The combination with a telephone line extending to two connection terminals, of a connection register associated with each terminal, means for completing connection with either terminal, and means adapted to actuate either connection register placed in operative relation therewith in making connection with the associated connection terminal.

869,450. MEASURED SERVICE SYSTEM FOR TELEPHONE LINES; J. L. McQuarrie, Oak Park, Ill. App. filed Feb. 23, 1906. Relates to modifications of the above.

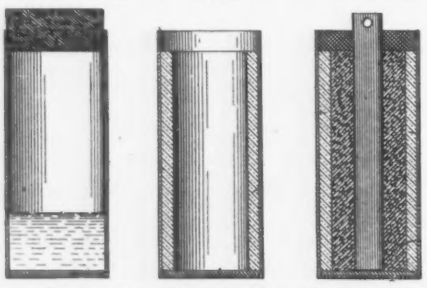
869,454. AUTOMATIC TESTING AND RESETTING MEANS FOR ELECTROTHERMAL PROTECTORS; F. B. Cook, Chicago, Ill. App. filed May 19, 1906. A testing device for a heat cartridge operable in a given direction, comprising means for applying current to the cartridge to heat the same, and for operating the cartridge still farther in the same direction when thus heated, as a test on the latter.

869,455. MOTOR CAR; S. Otis and H. S. Hart, Chicago, Ill. App. filed July 26, 1906. A car in which the motor mechanism is so located as to take up a minimum amount of space and be readily accessible at all times to the motorman; also to provide an improved motor, and other objects.

869,456. MOTOR RAILWAY TRUCK; S. Otis, Chicago, Ill. App. filed Nov. 7, 1906. A motor truck in which the main driving motor may be operated continually in the same direction of rotation, while the drive wheels of the truck may have their direction of rotation reversed. Has beveled gear mechanism with clutches.

869,459. ELECTRIC RAILWAY SYSTEM; W. B. Potter, Schenectady, N. Y. App. filed April 3, 1900. Relates to sectional electric railway systems provided with means for preventing trains from approaching nearer to each other than the length of the section. Has arrangements for operating the brakes and signaling devices especially adapted to the system.

869,460. ELECTRIC-HEATING FABRIC; W. Richmond, Memphis,



869,446—Process for Making Dry Cells.

Tenn. App. filed June 16, 1905. A resistance wire is wound on asbestos cord and the latter disposed in a spiral form to constitute a mat.

869,462. ALARM DEAD LOCK; M. Sheinman, New York, N. Y. App. filed Aug. 8, 1906. Alarm locks for doors having means for closing an electric alarm circuit should an attempt be made to force open the locking bolt from the outer side of the door by means of a knife blade or similar instrument.

869,464. ELECTRIC HEATER; G. E. Stevens, Lynn, Mass. App. filed May 23, 1904. A water heater of the type having vertical tubes through which the water flows and between which the spiral resistance elements are disposed.

869,465. THIRD-RAIL CONTACT SHOE; S. B. Stewart, Jr., Schenectady, N. Y. App. filed July 5, 1902. A collector shoe of the type in use on electric trains for underneath contact rails. Relates to mechanical features of construction.

869,467. RAILWAY SIGNAL; C. W. S. Turner, Mountville, Va. App. filed Feb. 1, 1907. Mechanical and electrical features of construction of a block-signal system having sectional rails energized by a direct current and employing polarized relays.

869,468. ELECTRIC SIGN; W. Wallace, Philadelphia, Pa. App. filed July 2, 1906. Provides means for mechanically and electrically connecting the letters of a sign to a supporting board having parallel circuits by which each letter can be attached wherever desired.

869,531. RAILWAY SIGNALING; J. B. Struble, New York, N. Y. App. filed June 28, 1906. Relates to the use of apparatus by means of which an alternating current in the railway conductors may be changed to direct current and used in circuits for controlling the passage of the trains.

869,552. SIGNAL APPARATUS; C. W. Coleman, Westfield, N. J. App. filed Feb. 4, 1907. A signal has normal bias to danger position and normally operates to go to danger position in response to said bias. Has a fluid-pressure piston motor for moving the signal to safety position.

869,555. BLOCK-SIGNAL SYSTEM; W. Daves, Bloomington, Ill. App. filed April 22, 1907. Provides a signal system in which any negligent action on the part of the signal man in the manipulation of the apparatus at his station will positively result in the display and maintenance of a danger signal until normal conditions are resumed.

869,576. SIGNALING SYSTEM; E. E. Kleinschmidt, New York, N. Y. App. filed Aug. 10, 1906. Block-signaling system for single-track electric roads in which the return current is carried by rails. Has means for registering the number of cars which enter a block in both directions.

869,591. METHOD OF PREPARING METALLIC POWDERS; W. P. McNulty, Alleghany, Pa. App. filed Jan. 25, 1906. The method of treating metallic powders for electroplating purposes consisting in cleansing them from greasy impurities.

869,595. TRANSFORMATION OF ELECTRIC CURRENTS; Wm. T. Taylor, Chihuahua, Mexico. App. filed March 14, 1907. Composite polyphase system of distribution.

869,599. HYGIENIC CARTRIDGE BATTERY; W. Thompson and J. C. Martin, Spokane, Wash. App. filed July 26, 1906. A medical battery consisting of two cylindrical sections rotatably jointed together, one section containing a dry cell, and the other section containing an induction coil and having an insulated cap, the sectional cylinder and insulating cap being respectively in circuit with the terminals of the secondary winding of the induction coil.

869,602. ELECTRICAL APPARATUS; T. W. Varley, New York, N. Y. App. filed Feb. 21, 1906. Relates to an electrical apparatus adapted to operate at a constant speed ratio irrespective of changes in the operating circuit.

869,634. WIRELESS TELEGRAPHY; W. S. Hogg, United States Navy. App. filed Feb. 6, 1907. A spark gap apparatus employing two electrodes having rounded terminals with proximate edges of highest potential parallel throughout and concentrically arranged with respect to each other.

869,711. TROLLEY; S. D. Hunt, Youngstown, Ohio. App. filed April 24, 1907. In place of a trolley wheel, patentee has a pair of rounded fingers with ball and socket connections to the part and which are guided between separate trolley wires.

869,714. WIRELESS SIGNALING SYSTEM; J. L. Jones, Kizer, Tenn. App. filed Aug. 24, 1906. Relates to systems of intercommunication between moving railway trains, or between trains and stations by wireless telegraphy.

869,728. ALARM MECHANISM; L. Paisley, Waverly, Ohio. App. filed May 8, 1906. Relates to alarm mechanism for rural free delivery mail boxes to notify the user of the presence of mail matter in the box.

869,737. MULTIPLE SOCKET FOR INCANDESCENT LAMPS; F. J. Russell. App. filed May 29, 1907. A multiple lamp socket having a body part carrying a series of lamp-holding contacts with a detachable lid carrying a series of corresponding center contacts for the lamp.

869,760. ELECTRICALLY CONTROLLED ELEVATOR; C. T. Westlin, Arlington, N. J. App. filed March 2, 1907. In an electrically controlled elevator, a door lock in the controlling circuit, said door lock arranged to break the path of the circuit when the door lock is open, and means for shunting a part of said current around the door lock.

869,780. ELECTRIC MOTOR; J. F. Hayes, Pittsburg, Pa. App. filed March 8, 1907. Relates to electromagnetic motors of the reciprocating type, and provides a motor of this character so constructed as to insure powerful and efficient action of the reciprocating armature.

869,796. SERIES SHUNT FOR DYNAMO ELECTRIC MACHINES; E. T. Mug, Norwood, Ohio. App. filed Nov. 17, 1905. Relates to resistance elements, particularly to series shunts for compound-wound, dynamo-electric machines. Has a plurality of strips of metal, means for clamping the ends of the strips and means for forcing said clamping means apart.

869,812. CONTROLLER; E. W. Stull, Norwood, Ohio. App. filed Aug. 17, 1904. Motor-control system for a plurality of motors designed to obtain a uniform acceleration of the motors through series and parallel connections.

869,824. CONTROL SYSTEM; L. M. Aspinwall, Wilkinsburg, Pa. App. filed Jan. 3, 1905. Controlling systems for electrical translating devices. Provides means for preventing the formation of such circuit connections in the power motors that they may act as generators and deliver current to the controlling devices.

869,825. MECHANICAL SHAFT OSCILLATOR; W. F. Bouché, Norwood, Ohio. App. filed June 16, 1904. A device for reciprocating the shaft of a motor or generator in its bearings and including an eccentric disc contacting with the end of the shaft and freely revoluble on roller bearings.

869,840. DENTAL ENGINE; W. E. Hanson, Biddeford, Maine. App. filed Feb. 21, 1907. Details of a supporting arm for the flexible shaft of a dental motor.

869,843. TROLLEY HEAD FOR ELECTRIC TRACTION; G. B. Holmes and A. D. Allen, Wellington, New Zealand. App. filed Aug. 7, 1907. The axle of a trolley wheel is mounted in journal blocks which have a slidable yielding movement.

869,852. CLIP FOR ELECTRICAL APPARATUS; H. Krantz, Brooklyn, N. Y. App. filed July 5, 1904. A clip for electrical apparatus, such as knife switches, fuse holders and the like, which are adapted to be secured on a suitable base and are provided with upstanding plate-like members to which a switch blade may be attached.

869,864. AUTOMATIC RESETTING AND TESTING FOR THERMAL PROTECTORS; F. B. Cook, Chicago, Ill. App. filed April 28, 1906. A resetting tool for a reversible electro-thermal protector having a central operable member, comprising electro-mechanical means for heating the protector and operating the central operable member in one direction to set the protector for another operation in a reversed direction.